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SCIENCE & TECHNOLOGY

CHINA

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CHRONOLOGY OF CHINA'S SUCCESSFUL SATELLITE LAUNCHINGS

Beijing KEXUE RIBAO in Chinese 11 Aug 87 p 1

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No.	Name	Date of Launch	Notes
1	Earth Satellite	24 April 1970	Weight: 173 kg; broadcast the song "East Is Red" on frequency of 20.009 MHz
2	Scientific Experiment Satellite	3 March 1971	Weight: 221 kg; orbit time: 106 minutes; transmitted experimental date to ground stations from 3-15 March on frequencies of 20.009 and 19.995 MHz
3	Earth Satellite	26 July 1975	All on-board instruments functioned normally; orbit time: 91 minutes
4	Earth Satellite	26 November 1975	This was China's first recoverable satellite; returned to Earth 2 December 1975 on schedule
5	Earth Satellite	16 December 1975	Satellite functioned normally
6	Earth Satellite	30 August 1976	Satellite functioned normally
7	Earth Satellite	7 December 1976	Satellite recovered on schedule on 10 December 1976
8	Earth Satellite	26 January 1978	Satellite recovered on schedule on 30 January 1978
9	Space Physics Probe	20 September 1981	This three-in-one satellite marked China's first multiple launch using a single launch vehicle
10	Space Physics Probe	20 September 1981	
11	Space Physics Probe	20 September 1981	
12	Scientific Experiment Satellite	9 September 1982	Satellite recovered on schedule on 14 September 1982
13	Scientific Experiment Satellite	19 August 1983	Satellite recovered on schedule on 24 August 1983

[chart continued from previous page]

14	Scientific Experiment Satellite	29 January 1984	Satellite functioned normally
15	Experimental Communications Satellite	8 April 1984	This was China's first geostationary communications satellite; was placed in equatorial plane at 125 degrees Longitude
16	Scientific Experiment Satellite	12 September 1984	Satellite recovered on schedule on 17 September 1984
17	Scientific Probe & Tech. Satellite	21 October 1985	Satellite recovered on schedule on 26 October 1985
18	Practical Broadcast Satellite	1 February 1986	Placed in an orbit of 103 degrees East Longitude on 20 February 1986 at 1700 hrs
19	Scientific Probe & Tech. Satellite	6 October 1986	Satellite recovered on schedule on 11 October 1986
20	Scientific Probe & Tech. Satellite	5 August 1987	Satellite recovered on schedule on 10 August 1987

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SMOOTHING TECHNIQUE TO RESOLVE X-RAY SPECTRA IN LASER NUCLEAR FUSION

40080094 Beijing JISUAN WULI [CHINESE JOURNAL OF COMPUTATIONAL PHYSICS] in Chinese Vol 2 No 2, Sep 85 pp 313-320

[Article by Liu Chenghai [0491 2052 3189] of the Institute of Atomic Energy and Lu Zhengqiang [7120 2973 1730] of the Institute of Applied Physics and Mathematics. Manuscript received 17 Jul 1984.]

[Text] Abstract: This paper provides a finite amplitude iteration method with periodic smoothing which has been used in resolving X-ray energy spectra in laser nuclear fusion with quite good results. By constructing a smoothed weighted function and using this weighted function to do smoothing treatment of iteration spectra in iteration processes, we eliminate the X-ray energy spectrum numerical structures produced in iteration processes, improve iteration convergence, and increase the spectrum resolution level. The paper also discusses the physical basis of smoothing, provides a theoretical analysis, and experimental results concerning the smoothing parameter as well as weighted function width selection.

I. Introduction

In laser nuclear fusion research it is necessary, based on the measurement results of multichannel sub-kilo electron volt X-ray line energy spectrometers (i.e., Dante spectrometers), multiple channel K-sided filter spectrometers, and multiple channel K-sided fluorescence spectrometers, to calculate back to the X-ray energy spectrum of the target plasma emission. For this reason we have developed studies on spectrum resolution methods.(1) W.N. Mcelrog et al., (2) have proposed an iteration method (for brevity this is referred to below by its program name as the SAND iteration method) used on measurement results based on activation foil to compute neutron energy spectrums. As a probe we used the SAND iteration method to resolve the X-ray energy spectrum in laser fusion. The results showed that although this sort of method was capable of resolving an X-ray energy spectrum generally approximating the actual spectrum, there was frequently present in the resolved spectrum results several numerical structures. Moreover it required an initial heuristic spectrum not far from the true spectrum. If the initial heuristic spectrum was farther from the true spectrum, then numerical instabilities could appear or non-physical "negative spectrums." This motivated us to do further exploration of iteration spectrum resolution methods whereupon a limited amplitude iteration method with periodic smoothing was formed on the foundations of the SAND iteration method. This

procedure clearly improved the spectrum resolution results and adaptive behavior with respect to the initial heuristic spectrum.(1) The special topic of this paper is to introduce the smoothing techniques of the X-ray spectrum resolution method. Below, as background to the proposed smoothing techniques we first introduce the SAND iteration method and the numerical structure in its spectrum resolution results. This is followed by presentation of the smoothing methods, the physical basis and theoretical analysis of smoothing, and finally the empirical results of given smoothing parameters and weight function width selections.

II. The SAND Iteration Method and the Numerical Structures in its Spectrum Resolution Results

In the problem of X-ray spectrum resolution, the integral equations to be solved are(1,2)

$$Y_i = \int_{E_{min}}^{E_{max}} g(E)R_i(E)dE \tag{2.1}$$

in which $I = 1, 2, \ldots, I_m$ is the X-ray energy spectrometer probe channel sequence code, E is the X-ray energy, Y_I is the X-ray energy spectrometer Ith probe channel output signal measurement value (amplitude or charge), g(E) is the X-ray line energy spectrum to be measured, R(E) is the response function of the ith probe channel. It is defined as the output quantity (amplitude or charge) produced at the ith probe channel by the photon energy as unit energy X-ray lines of E. This is related to the type of operating principle of the spectrometer (filter method or filter-fluorescence method), the various probe channel operating materials of the spectrometer (filter plates or fluorescence plates), spectrographic properties and their mass thickness, the various probe channel solid angle factors, and the sensitivity of the spectrometer recording system. For simplicity and so as not to obstruct the central discussion of this paper, we do not write out their concrete forms.

The iteration formula of the SAND method is(1)

$$g_j^{L+1} = g_j^L \exp(-C_j^L) \tag{2.2}$$

in which $j = 1, 2, \ldots, J(J >> I_m)$ is the discretized energy grid sequence code, L is the iteration counter index, g_j^L is the X-ray energy spectrum resolved by the Lth iteration, and C_j^L is the revised exponent of the L + 1 iteration

$$C_j^L = \frac{\sum_{i=1}^{I_m} W_{i,j}^L \ln B_i^L}{\sum_{i=1}^{I_m} W_{i,j}^L} \tag{2.3}$$

in which

$$B_j^L = -\frac{Y_j^L}{Y_j} \tag{2.4}$$

$$W_{L,j}^L = \frac{Y_{j,j}^L}{Y^L} \tag{2.5}$$

Here

$$Y_{j,j}^L = \delta_j^L R_{i,j} \Delta E_j \tag{2.6}$$

$$Y^L = \sum_{j=1}^{J} Y_{i,j}^L \tag{2.7}$$

and $R_{i,j}$ is the response function value of the ith probe channel with respect to the jth energy group X-rays

$$R_{i,j} = \frac{1}{\Delta E_j} \int_{E_j - \frac{1}{2}}^{E_j + \frac{1}{2}} R_i(E)\, dE \tag{2.8}$$

when the condition

$$\sum_{j=1}^{I_m} \frac{\sqrt{(Y_i^L - Y_i)^2}}{Y_i} \geq \varepsilon \tag{2.9}$$

is satisfied then the iterations cease. Here, ε is the iteration precision control parameter and $0 < \varepsilon << 1$.

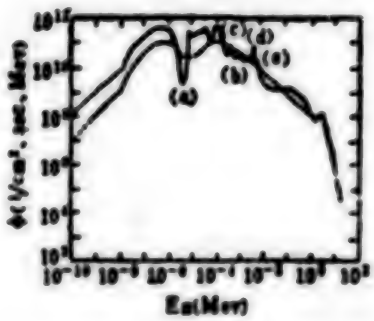

Fig. 1. A Neutron Energy Spectrum Resolved From Activation Foil Measurements Using the SAND Iteration Method. The dashed line is the true spectrum (test spectrum) and the solid line is the computed result.

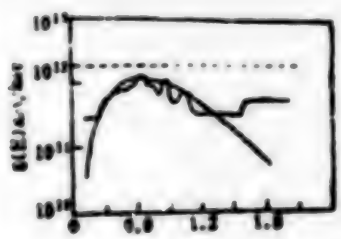

Fig. 2. An X-ray Energy Spectrum Resolved From Activation Foil Measurements Using the SAND Iteration Method. The dashed line is the true spectrum (test spectrum) and the solid line is the computed result.

Figure 1 provides the neutron energy spectrum resolved based on the results of activation foil measurements using the SAND iteration spectrum we resolved based on measurement results with a multiple channel sub-kilo electron volt X-ray line energy spectrometer making use of the SAND iteration method. The results of Fig. 1 and Fig. 2 show that although the spectrum resolved using the SAND iteration method is able to approach generally the true spectrum (the test spectrum se[illegible] the method), approximate results obviously cannot be satisfying. The [illegible]inal true spectrum is relatively smooth but there are several wavy structures present in the results from the SAND iteration method. These structures are produced in numerical computations so we call them numerical structures. Correspondingly, the energy spectrum structures present in X-rays and neutrons themselves we call physical structures.

Through analysis we discovered that the numerical structure in the spectrum resolution results could be divided into three types.

1. "Hereditary factors" of the spectrometer response function.

As indicated in reference (2), the (n,γ) response resonance peak of the numerical structure (a) and (b) with respect to activation foil A_u^{197} and the $n,\gamma)$ response resonance peak of the wavy structures (c) and (e) with respect to the activation foil C_o^{59}.

2. "Hereditary factor" of the initial heuristic spectrum.

In Fig. 2 the initial heuristic spectrum used during computation is a flat spectrum while in the resolved spectrum results there also appears a very broad "flat bottom wave valley" (i.e. the 1.1 kev $\leq E \leq$ 1.56 kev energy range). This indicates the resolved spectrum preserves factors inherited from the initial heuristic spectrum.

3. Composite effect

There are some numerical structures which do not clearly belong to hereditary factors of the response function or the initial heuristic spectrum. These structures are the composite result of various effects (e.g. the response function structure, the initial heuristic spectrum shape, and various energy group independent corrections in the iteration method).

III. Smoothing Process Methods

As recounted above, in the use of the SAND iteration method to resolve neutron or X-ray energy spectra, obvious numerical structures are produced in the results. These structures bring a certain difficulty to the analysis of spectra resolution results. In actual laser target experiments, we will have no means to distinguish the physical structures from the numerical structures in resolved spectrum results. Moreover, these numerical structures also necessarily lower the efficiency of the resolved spectrum results with respect to the true spectrum. The inherited factor of the initial heuristic spectrum

results demonstrates a relationship between the two which has made us and colleagues doing spectrum resolution research in other fields all feel very perplexed.

We note that in the many methods of computational physics, each proposes individual smoothing techniques from consideration of different physical concerns (see for example references (3-5). In view of the numerical structures produced using the SAND iteration method for spectrum resolution we propose the following smoothing method.

First, we construct a smoothing weight function on a discretized spectrum resolution energy grid

$$W_{j,j'} = R_{T,j'} G_{j,j'} \tag{3.1}$$

in which j = 1, 2, ... J, j' = 1, 2 ... J. This smoothing weight function includes two independent factors. The first is

$$R_{T,j} = \sum_{i=1}^{I_m} R_{i,j}, \tag{3.2}$$

This is the sum of spectrometer's various probe channels with respect to the j energy group X-ray response function. The second factor is the discrete Gauss distribution

$$G_{j,j'} = \frac{1}{\sqrt{\pi}\sigma} \exp\left\{ - \frac{(E_j - E_{j'})^2}{\sigma^2} \right\} \tag{3.3}$$

in which σ is the Gauss weight function width.

Next, in the iteration process, smoothing treatment is done once for every Ns line separations, i.e. we make

$$\bar{g}_j^L = \frac{\sum_{j'=1}^{J} W_{j,j'} g_{j'}^L}{\sum_{j'=1}^{J} W_{j,j'}} \tag{3.4}$$

and then the X-ray energy spectrum g_j^{-L} after smoothing is substituted into the next iteration. This way a periodic smoothing treatment is done during the iteration process. When the precision has attained a certain requirement, i.e. when

$$Q = \frac{1}{I_m} \sum \sqrt{(Y_i^L - Y_i)^2} / Y_i \leq \epsilon_1 \tag{3.5}$$

then the smoothing avenue is closed down. Afterwards, further increased precision requires continued iterations without smoothing to restore physical structures of the energy spectrum leveled out in the smoothing process. These iterations continue until

$$Q \leqslant \varepsilon_1 \tag{3.6}$$

in which $0 < \varepsilon_2 \ll \varepsilon_1 \ll 1$.

IV. Physical Foundation and Theoretical Analysis of Smoothing

As is widely known, in the methods of computational physics, the various smoothing techniques applied each have their individual physical foundations. In X-ray spectrum resolution methods for laser fusion, the physical foundation of smoothing can roughly be divided into two aspects.

The first of these is that in laser-plasma iterations the X-ray production mechanisms are emission (f-f), photoelectric emission (f-b), and line emission (b-b) after absorption of laser energy by the target plasma. The X-rays emitted by the first two mechanisms are continuous spectra while the last are line spectra. In laser amplitude illumination low Z experiments, the target plasma is basically completely ionized and the X-rays emitted have continuous spectra. In laser amplitude illumination medium Z and high Z target experiments, the target plasma is partially ionized so in addition to continuous spectrum X-rays, line spectrum X-rays will also be emitted. Theoretical and experimental research both show that in these sort of experiments, the line spectra superimposed upon the continuous spectra are rather rich and that their average effect is still fairly smooth.

The second aspect is that both multiple channel K-sided X-ray energy spectrometers (including the Dante spectrometer) and multiple channel K-sided filter fluorescent spectrometers are diagnostic apparatus for continuous X-ray spectra. In these sort of spectrometers, regardless of whether it is the energy band width of the primary response zone of each probe or the energy separation between the various probes, they are always much bigger than the width of a single spectral line. Therefore, these sorts of spectrometers do not possess the ability to distinguish a spectral line. As for the spectral lines superimposed upon a continuous spectrum background, what they receive is an average effect from a large quantity of spectral lines. The results of spectrometer measurements contain only information on the average effect of the spectral lines superimposed on the continuous X-ray spectrum. Information on the detailed structure of these spectral lines has been buried.

In view of the fact that the diagnostic aim of both K-sided spectrometers and K-sided filter fluorescent spectrometers is measurement of continuous X-ray spectra and the average effect of spectral lines emitted by the target plasma, they do not require, and are incapable of, analyzing out the fine structure of line spectra through spectrum resolution programs. In fact, because the information on the X-ray spectral line structure is already buried in the measurement results of these sort of spectrometers, spectrum resolution programs are unable to "salvage" the buried information. If there appear in the computation

results of spectrum resolution programs narrow wavy structures with several energy widths, then we should note that these wavy structures are not necessarily specially measured physical structures of X-ray spectra and are more likely to be numerical structures. For this reason we introduced smoothing techniques.

Below we do some analysis of the two factors in the smoothing weight function.

Using formula (3.4) as the smoothing treatment, we take the summation operator $\sum_{j'}$ on the formal side and all the energy grids ($j' = 1, 2 \ldots, J$). However, if the selection of the Gauss weight function width, σ, is suitable, then the primary contribution of the right side of formula (3.4) is located in a fuzzy boundary neighborhood near the jth grid.

We note that within the spectrum resolution energy zone between $[E_{min}, E_{max}]$, the zone can be divided into three different response zones according to the spectrometer response characteristics. The first is located within an energy zone with a fixed width below the energy of a certain probe channel's K-sides. Said probe channel is very sensitive with respect to X-ray responses of this energy zone while the other probes are relatively insensitive. This energy zone is called the primary response zone of the particular probe channel. The second response zone does not belong to the primary response zone of any particular probe channel, however, the summation of the various probe channels with respect to that energy zone X-ray response function value, $R_{T,j} = \sum_{i} R_{i,j}$ is still objective. We call this sort of energy zone the total sensitive zone. In the third type, the sum of the various probe channels with respect to that energy response function value, $R_{T,j}$ is very small. We call this energy zone the "near blind zone."

The first two energy zones belong to the sensitive zone and the iteration results of the sensitive zone approach quite well the true spectrum. The near blind zone is very insensitive and here it is often easy for traces of the initial spectrum to "survive." At the intersection of the sensitive zones and the near blind zone, it is easy for wavy structures to be produced. In the smoothing weight function of (3.1), the action of factor $R_{T,j'}$ is to do a time average in the j grid vicinity giving $R_{T,j'}$ a larger grid and a larger weight while giving $R_{T,j'}$ a smaller grid and smaller weight, consequently gradually eliminating the influence of the near blind zone.

In order to explain the action of the Gauss weight function in the smoothing treatment, we adopt harmonic wave analysis methods. For this we let the spectrometer response characteristic be "flat response zone," that is, $R_{T,j'}$ = constant. Moreover the energy grids are uniformly divided that is, $E_j = j\Delta E$. Here $j = 0, 1, 2, \ldots, J-1$. To facilitate the analysis, we do a renumbering of the energy grids in sequence and let $J = 2^N$, N being an integer much larger than one. Thereupon, the smoothing function becomes

$$\bar{g}_j = \sum_{j'=0}^{J-1} g_{j'} \frac{1}{\sqrt{\pi}\sigma} \exp\left\{-\frac{\Delta E^2}{\sigma^2}(j-j')^2\right\} \tag{4.1}$$

in which j = 0, 1, ..., J - 1. For simplification henceforth we write the interation sequence index, "L." $\bar{g}_j$ and the Gauss distribution is expanded as a discrete number sequence with period J. In addition, a finite Fourier transform is done on both sides of formula (4.1) and the discrete convolution theorem used to obtain(6)

$$\hat{\bar{g}}_k = \hat{g}_k \hat{G}_k \tag{4.2}$$

in which $\hat{g}_K$ and $\hat{\bar{g}}_K$ are the finite Fourier transforms of X-ray iteration spectra before and after smoothing

$$\hat{g}_k = \sum_{j=0}^{J-1} g_j \exp\left(-i\frac{2\pi jK}{J}\right) \tag{4.3}$$

$$\hat{\bar{g}}_k = \sum_{j=0}^{J-1} \bar{g}_j \exp\left\{-i\frac{2\pi jK}{J}\right\} \tag{4.3}$$

while the finite discrete Fourier transforms of the Gauss distribution are well known(7)

$$\hat{G}_k = \exp\left\{-\left(\frac{\pi K}{J}\frac{\sigma}{\Delta E}\right)^2\right\} \tag{4.4}$$

in which, K = 0, 1, 2, ..., J-1 are the discrete wave numbers (their units are $2\pi/J\Delta E$). Here the wave number and wave length spoken of during analysis of wave forms of X-ray energy spectra do not refer to the X-rays themselves, but rather are the wave forms of the X-ray energy spectra. We substitute units of discrete wave number K, introducing the physical wave number

$$k = \frac{2\pi K}{J\Delta E} \tag{4.5}$$

then

$$\hat{\bar{g}}_k = \hat{G}_k \hat{g}_k \tag{4.6}$$

$$G_k = \exp\left(-\frac{1}{4}k^2\sigma^2\right) \tag{4.7}$$

We note when k ---> 0, $\hat{G}_k$ ---> 1, with increasing k (i.e. wave length shortening) $\hat{G}_K$ gets is smaller, that is using Gauss weight function as smoothing treatment for X-ray energy spectra basically has no effect on wave lengths in the X-ray spectrum wave form structure and has a leveling action on short wave structures. As the wave lengths get longer the smoothing action gets bigger. In Fig. 3, we give the variation of the Gauss weight function Fourier transform, $\hat{G}_k$, with k (in which we take $\sigma = 0.05\ \Delta E$).

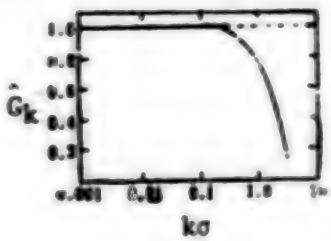

Fig. 3. Variation of the Gauss Weight Function Fourier Transform, $\hat{G}_k$ with kσ

V. Selection of Gauss Weight Function Width and Smoothing Parameters

In order to master the rules of the smoothing method, we did a series of computations with respect to different Gauss weight function widths and smoothing parameters. In Fig. 4 we give the computational results of spectrum resolution done on the basis of Dante spectrometer measurement results in the sub-kilo electron volt energy range. We considered that the spectrum resolution computations are in the low energy zone where the energy grid is more dense and that with energy increase the grid also becomes correspondingly steadily more rarified. Therefore we chose variable Gauss weight function widths $\sigma = \alpha E$, and used $\alpha = 0.01$, 0.02, 0.05, 0.2, and 0.3. The optical smoothing parameter, Ns = 1.

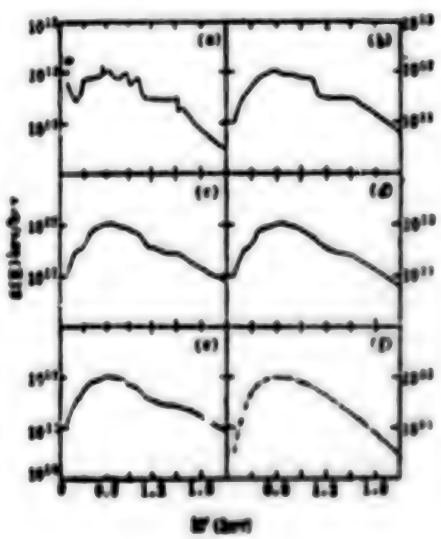

Fig. 4. Spectrum Resolution Results using Different Gauss Weight Function Widths as Smoothing Treatment.
(a) $\alpha = 0.01$, (b) $\alpha = 0.02$, (c) $\alpha = 0.05$, (d) $\alpha = 0.2$, (e) $\alpha = 0.3$, and (f) is the true spectrum (test spectrum).

These results show that taking $\alpha = 0.01$ makes the Gauss weight function too narrow and the smoothing has no effect leaving many numerical structures in the resolved spectrum. When $\alpha \geq 0.2$, the smoothing is clearly evident.

The selection principle for the Gauss weight function is for it to be larger than the energy grid width of the resolved spectrum, ΔE_j, yet smaller than the intrinsic resolution width of the spectrometer.

Under the premise of initiating smoothing action it should not be chosen too wide to avoid as much as possible leveling out the physical structures of the X-ray energy spectrum. (Of course our method included continued iterations after smoothing to restore the physical structures leveled out during smoothing.) On the basis of the above considerations we considered the selection of $\alpha = 0.05$ to be the most suitable.

In Fig. 5 we present the results of spectrum resolution computations done for different smoothing parameters. In these computations the Gauss weight function width coefficient was set at $\alpha = 0.05$. The smoothing parameter was taken at Ns = 1, 5, 10, 20, 40, and infinity (Ns = infinity meaning that no smoothing was done).

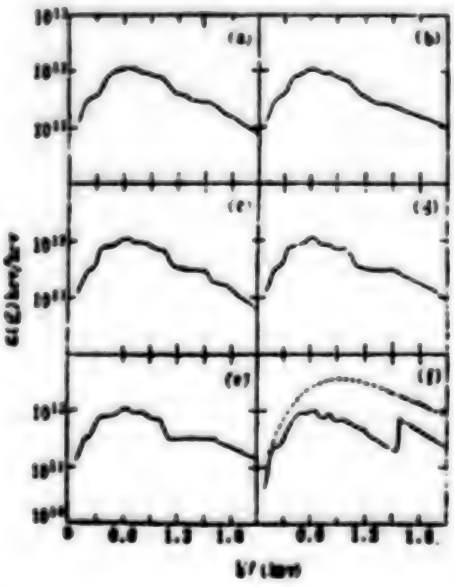

Fig. 5. Spectrum Resolution Results Using Different Smoothing Parameters, Ns. (a) Ns = 1, (b) Ns = 5, (c) Ns = 10, (d) Ns = 30, (3) Ns = 40, and (f) Ns = infinity (no smoothing treatment). The true spectrum is the same as (f) in Fig. 4 and is the initial heuristic spectrum.

These results indicate that when the smoothing parameter is smaller, for example if Ns = 1, 5, the computed results are pretty good. When the smoothing parameter is larger then some numerical structures still persist in the computed resolved spectra.

The principle for selection of the smoothing parameter, under the premise of ensuring obvious action from the smoothing treatment, is for Ns not to be too small so as to facilitate as much as possible economy of operation time. According to this principle, we feel that Ns = 5 is best.

VI. Conclusion

There exists a physical basis and reality for the introduction of smoothing techniques in X-ray spectrum resolution methods. After the adoption of smoothing techniques there is an obviously improved operating level of spectrum resolution.

Actual computations and theoretical analysis both demonstrate that the use of the smoothing weight function selected by this paper is capable of rather effectively eliminating inherited factors from the response function and the initial heuristic spectrum as well as short wave numerical structures.

The proposed principles for the selection of the smoothing weight function width and the smoothing parameter are universal and the range of concrete values selected can serve as a reference.

The smoothing method can be applied to resolution of neutron spectra.

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12966/7358

'MAGIC LIGHT' HIGH-POWER LASER PASSES STATE CERTIFICATION

40080012 Shanghai YINGYONG JIGUANG [APPLIED LASER] in Chinese Vol 7 No 4, Aug 87 p 159

[Text] The "Magic Light" high-power laser developed by the Shanghai Institute of Optics and Fine Mechanics passed its state certification on 26 and 27 June. Fourteen famous scientists and academic committee members of the Chinese Academy of Sciences were present, including Wang Ganchang [3769 3227 2490], Wang Daheng [3769 1129 3801], Yu Min [0060 2404], Chen Nunkuan [7115 1401], Cheng Kaijia [4453 7030 3946], and Gan Fuxi [1626 4395 3588].

Under the strong support of the Ministry of Nuclear Engineering Industry, the "Magic Light" project went through 2 years of technical and engineer research during 1980-1981, and was completed in 3 1/2 years from January 1982 to July 1985. In this period the Shanghai Institute devoted about one-third of their manpower to the project and received the support of 20 other units including the Ministry of Electronics Industry and the Ministry of Defense Industry.

The system consists of two parallel branches of lasers, each branch has a number of amplifiers, isolators and spatial filters. In the 100 meter of optical path, the two laser beams are synchronized to an accuracy of better than 3 mm. The pulse widths are 0.1 ns, 1 ns, and 3 ns, and the output power is 10^{12} W. At the end of 1986, three important target shooting experiments were conducted in which the overall performance was improved and the expected goals were achieved.

The development of the "Magic Light" project has carried along more than 10 other high technology projects. Unique and novel results have been obtained in the development of phosphate glass, lens array, self-adjusting wavefront compensation system, photoconduction switch, laser power supply system, single-longitudinal mode Q-switched oscillator, and high precision focusing system. Experts on the certification committee all agreed that "Magic Light" is a success story of China's high technology development. It has achieved international standards and represents a major accomplishment of China's laser technology.

From a scientific research point of view, the "Magic Light" laser will be used mainly for conducting basic research in laser fusion, high temperature high pressure and high density plasma physics, highly ionized atomic physics research, laser particle accelerator, and material states under extreme physical conditic s. The "Magic Light" laser laboratories will be gradually opened to scientists here and abroad.

PROTECTION AGAINST LASER DAMAGE TO HUMAN BODY REVIEWED

40080012 Shanghai YINGYONG JIGUANG [APPLIED LASER] in Chinese Vol 7 No 4, Aug 87 pp 172-176

[Article by Yan Bingyu [7346 3521 3768], Beijing Institute of Opto-Electronic Technology: "The Damage of Lasers to the Human Body and Methods of Protection"]

[Text] Abstract: Lasers can cause damage to the human eye. The international standards classify lasers into groups. This paper describes the main points of protection against laser damage.

Since its invention in the 1960's, the laser has seen rapid development and broad application. The burgeoning laser industry is attracting more and more workers and the proper use of lasers and the protection against bodily damage are important issues.

Along with the development of laser technology in China, Chinese-made laser equipment is also entering the international market. Our equipment must meet international standards on laser safety and protection. Because of these reasons, it is imperative that we understand the damage lasers can cause and the safety and protection standards.

1. Laser Damage to Human Body

Lasers cause damage mainly to the eye and to the skin. Skin damage is mostly burns but long-term exposure to certain ultraviolet wavelengths may also cause skin cancer.

Of most concern is laser damage to the human eye. There are several mechanisms for this damage: a temperature rise caused by the absorption of the light can burn the eye. Lasers can also cause photochemical changes in the tissue, and, in the case of ultraviolet light, in the protein of the cornea. Since the lens of the eye absorbs more long wavelength light, blue light 434-440 nm can easily cause photochemical reactions and lead to the so-called blue light damage (see Figure 1). An exposure of 10 seconds under a 10 mW argon laser can cause photochemical reaction. Figure 2 shows the damage threshold curves for an argon laser and a YAG laser. Short pulse lasers have a higher power density and a higher pressure wave associated with

the plasma flow, they can also produce damage and hemorrhage in the cornea, lens, and retina. Under certain conditions lasers can also ionize cell structures in the eye and lead to microphotoelectric and fluorescent reactions.

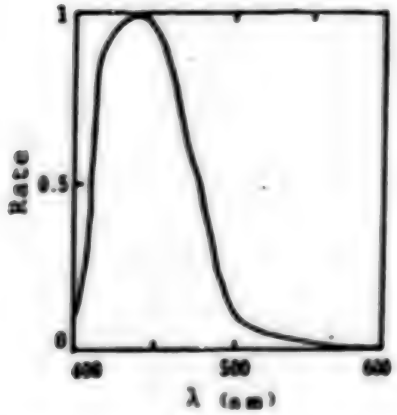

Figure 1. Photochemical damage to the retina caused by weak light as a function of wavelength

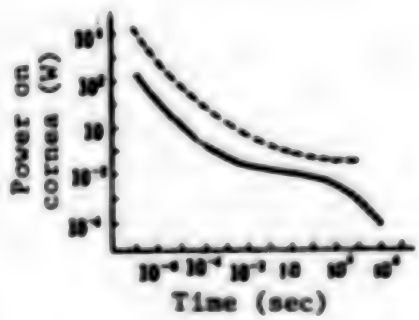

Figure 2. Laser damage threshold curves for argon laser (solid line) and YAG laser (broken line)

Laser damage to the eye depends very much on the wavelength. The cornea, lens, and vitreous body are almost transparent to visible light and 1.2 μm infrared, as shown in Figure 3. Due to the focusing effect of the cornea and the lens, the light intensity per unit area at the bottom of the eye is 10^4 times stronger than at the surface of the cornea. Since shorter wavelengths suffer a greater loss along the way and cannot reach the bottom of the eye, the rate of absorption of the blue light is the greatest at the bottom of the eye (see Figure 4).

The retina at the bottom of the eye is not uniform and the level of damage depends on the location. Near the axis there are yellow spots and visual cells that distinguish colors. Damage near the axis may reduce the vision to below 0.1 and cause color blindness. The surrounding retina has visual cells with high sensitivity but no color sensing ability; local damage in

this area may not affect the vision but extensive damage may affect the field of view and cause nyctalopia.

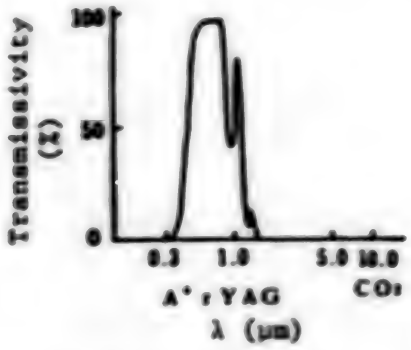

Figure 3. Percent of light reaching the bottom of the eye as a function of wavelength

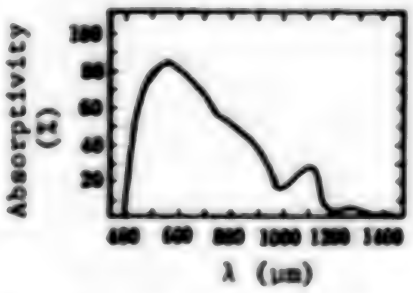

Figure 4. Percent of light absorbed by the bottom of the eye as a function of wavelength

Far infrared with a wavelength greater than 1.3 μm basically cannot enter the eye and is absorbed by the surface layer of the cornea. It therefore has an effect only on the surface. Rabbit eyes irradiated by 10.6 μm CO_2 laser light for 0.5 seconds suffered carbonized and blackened cornea. However, irradiation by 1.3 μm 0.8W YAG laser for 3 minutes had almost no effect except some slight cloudiness in the cornea 3 days after the irradiation.

The surface cells of the cornea have a strong ability for regeneration. The eye may hurt badly but the symptoms will disappear after a day or two. On the other hand, the cells in the cornea have a weak ability for regeneration and cloudiness in the cornea will remain permanently. Superficial damage to the cornea by CO_2 laser heals quickly, but deeper damage can reduce the vision and cannot be cured. When the damage is limited to the cornea, a transplant may cure the problem. Interior structural damages are much harder to treat. The vitreous body that fills most of the eye is a gel-like substance. Damage to the vitreous body causes it to become string-like and is also difficult to treat. The retina has no regeneration ability and once the visual cells are killed the vision in that part of the retina will be lost forever.

In the use and manufacture of lasers great care must be exercised to protect the eye. Safety precautions must be taken in using high-power lasers.

2. Classification Standard of Lasers

In August 1984 the IEC 825 international standard on the "Radiation Safety Standard of Laser Products and Devices, Device Classification, and Operating Regulations" was issued. In the same year a tentative draft IEC /6(Co)4 on the electrical protection of laser devices was also announced. The standard represents an accumulation of laser usage experience over many years and the results of extensive research.

The IEC 825 international standard divides lasers into four classes and assigns radiation critical values to each class. The classes indicate the level of danger of the lasers.

Class I laser devices (see Table 1) are safe equipments. The highest radiation level of class I devices is not harmful to the human body and no special precautions are needed. The output power of class I lasers will not cause damage in the total irradiation time. Or, the laser may belong to a higher class but the beam is shielded so that the operation is safe. The irradiation time of class I lasers may reach 30,000 seconds (8 hours) without causing any damage. The maximum radiation of class I lasers is safe for the eye and the skin; it will not exceed the damage threshold for the cornea or the skin even after focusing with a lens or telescope.

Table 1. Allowed Radiation Critical Values of Class I Laser Devices

λ(nm) \ t(s)	$<10^{-9}$	$5\times10^{-9}-10$	$10^{3}-3\times10^{4}$
200–302.5	2.4×10^{7}W	$2.4.10^{-3}$J	
302.5–315		$7.9\times10^{-3}C_{A}$J	$7.9\times10^{-3}C_{A}$J
315–400		$(t>T_{A})$	7.9×10^{-6}W
400–700	200 W	$7\times10^{-4}.t^{0.75}$J	3.9×10^{-7}W
700–1050	$200\,C_{A}$W	$7\times10^{-4}t^{0.75}C_{A}$J	$1.2\times10^{-4}C_{A}$W
1050–1400	2×10^{7}W	$3.5\times10^{-3}\times t^{0.75}$J	6×10^{-4}W
$1400-10^{5}$	8×10^{6}W	$4.4\times10^{-3}t^{0.75}$J	8×10^{-4}W
$10^{5}-10^{6}$	10^{7}W	$0.56\,t^{0.75}$J	0.1W

Class II lasers are low-power, visible light (400–700 nm) lasers. The irradiation time of class II lasers is 0.25 seconds and the critical power is the same as class I lasers. For continuous lasers the critical value is 1 mW (see Table 2).

Table 2. Allowed Radiation Critical Values of Class II Laser Devices

Wavelength λ(nm)	Time t(sec)	Class III boundary
400-700	$1 < 0.15$	Same as class I
	$1 \geq 0.25$	10^{-3}W

The irradiation time of 0.25 seconds was chosen not because class II lasers are not dangerous, it was chosen because the blinking reaction time of the eye to strong light is about 0.25 seconds. The automatic blinking reaction protects the eye. The cornea damage threshold is 2.5 mW/cm^2.

Class IIIA lasers can have a continuous output power of 5 mW in the 400-700 nm range and the critical value of pulsed lasers is 5 times that of class II lasers. It is dangerous to observe a class IIIA laser directly with a telescope. In the visible range, the blinking reaction protects the eye. See Table 3.

Table 3. Allowed Radiation Critical Values of Class IIIA Laser Devices

λ(nm) \ t(s)	$<10^{-9}$	5×10^{-5} - 0.25	10^{3} - 3×10^{4}
200-302.5	1.2×10^{5}W	1.2×10^{-4}J	
302.5-315		$4\times C_1\times10^{-6}$J	
315-400		$4\times C_1\times10^{-6}$J	4×10^{-5}W
400-700	1000W	$3.5\times10^{-3}\times t^{0.75}$J	5×10^{-3}W
700-1050	1000W $\times C_4$W	$3.5\times10^{-3}\times C_4\times t^{0.75}$J	$6\times10^{-4}\times C_4$W
1050-1400	10^{4}W	$1.8\times10^{-3}\times t^{0.75}$J	3×10^{-3}W
1400-10^{5}	4×10^{5}W	$2.2\times10^{-3}\times t^{0.25}$J	4×10^{-3}W
10^{3} - 10^{6}	5×10^{7}W	$2.8\times t^{0.25}$J	0.5W

Class IIIB lasers may have visible or invisible output. The power of CW lasers may not exceed 0.5W and pulsed lasers may not exceed 10^5J/m^2.

It is dangerous to observe class IIIB laser light beams in the vicinity of such laser devices. The scattered light or unfocused light of a pulsed class IIIB laser are not dangerous. Diffusely scattered CW laser light may be observed directly provided (a) the minimum observation distance is 13 cm, and (b) the maximum observation time is 10 seconds. If either condition is not satisfied, the diffuse light should be considered dangerous.

Class IV lasers (Table 4) are high-power laser devices. Their output power critical value exceeds that of class IIIB lasers and their diffuse light in the visible and near infrared range are also dangerous. It may cause burns or fires and should be used carefully. The laser manufacturers and their representatives have the responsibility of accurately classifying the laser devices.

Table 4. Allowed Radiation Critical Values of Class IVB Laser Devices

λ(nm) \ t(s)	$<10^{-9}$	$10^{-9} \sim 0.25$	$0.25 \sim 3\times10^{4}$
200-302.5	3.8×10^{3}W	3.8×10^{-4}J	1.5×10^{-3}W
302.5-315	$1.25\times10^{4}C_2$W	$1.25\times10^{-3}C_2$J	$5\times10^{-3}C_2$W
315-400	1.25×10^{5}W	0.125 J	0.5 W
400-700	3.14×10^{11}W.m^{-2}	$3.14\times10^{3}\ t^{0.33}$J.m^{-2} and $<10^{3}$J.m^{-2}	0.5 W
700-1050	$3.14\times10^{11}C_4$W.m^{-2}	$3.14\times10^{3}C_4\ t^{0.33}$J.m^{-2} and $<10^{3}$J.m^{-2}	0.5 W
1050-1400	1.57×10^{12}W.m^{-2}	$1.57\times10^{4}\ t^{0.33}$J.m^{-2} and $<10^{3}$J.m^{-2}	0.5 W
1400-10^{6}	10^{14}W.m^{-2}	10^{3}J.m^{-2}	0.5 W

The standard also provides detailed technical information to the laser manufacturers and users. Design information is given for protective covers of different class lasers. Laser classifications should also be clearly labelled. The users should take the appropriate precautions for lasers of different classifications. Adequate testing equipment and goggles should be used. The standard also provides instructions for laser usage in the laboratories, factories, hospitals, buildings and on screens. Finally, damage thresholds are given for the eye and skin.

3. Laser Safety Protective Measures

Different lasers require different safety measures. Class I lasers do not need special safety measures; protective goggles should be used in the repair of class I lasers. For class II lasers, because of the blinking reaction, no special safety precautions are called for except where continuous direct observations are required. Class IIIA lasers have a power level lower than 5 mW and a power density less than 25 mW/m^2. For a pupil diameter of 7 mm, the power entering the eye is less than 1 mW. Class IIIA lasers can therefore be treated the same as class II lasers for visible light and no special measures are needed. Caution should be taken when the beam is focused by optical instruments. For invisible light of a power level five times greater than class I lasers, the blinking reaction can no longer protect the eye and necessary protective measures must be taken even though the power level is less than that of a class IIIB laser. Class IIIB

lasers have a higher output power and goggles must be used. Class IV lasers can damage both the eye and the skin. Diffused light of class IV lasers is also dangerous. Such devices should be covered up as should the light beam. Goggles must be used in handling class IV lasers. Goggles can often be damaged and should be examined carefully.

In the remaining part of this paper we discuss the protective measures against possible danger in the operation of lasers.

In designing lasers the devices should be enclosed in protective shells. Observation windows should have filter glass and the outlet slit should have covers. The protective shell and the filter glass should have sufficient long term integrity. There should be beam restricting and collecting devices, invisible light should be converted into visible light, diffused light should be monitored, the height of the light beam should not be at the eye level, the laser devices should have safety switches, the area should have warning lights, and the classification of the laser and danger signs should be boldly marked on the protective shell.

Lasers should be installed in the proper places. The output port should be shielded and the light beam restricted. The walls should be nonreflecting for visible light, diffused light should be monitored, the door should have safety switches and warning lights and signs.

For personnel, the main protective measure is goggles. The side of the frame should also be covered. Protective clothing should be worn when handling high-power lasers. Power meters and energy meters should be used to monitor the output periodically.

Lasers are often powered by high-voltage sources. The circuit should be securely grounded, with good ventilation, and pilot lights and circuit breakers.

Laser devices also carry the danger of ultraviolet radiation, Roentgen radiation, and plasma tube explosion. Mechanical moving parts should be reliable. Attention should be given to hazardous vapors, laser medium poisoning (such as dye solutions), and the danger of fire.

At the Laser Parameter Measurement Center of the Beijing Institute of Opto-Electronic Technology, there are two ongoing projects on the measurement of laser parameters and laser safety and protection. These projects are sponsored by UNESCO. We plan to conduct laser safety training workshops and publish laser safety booklets to promote safety and prevent accidents.

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2. IEC 825 International Standards.

9698/6091

COMPUTER SECURITY ISSUES EXAMINED, PROPOSALS MADE

Focus on Computer Security

40080005 Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese 8 Sep 87 p 34

[Article by Hang Ji [5300 4764]: "Report of the Second Chinese Computer Security Technology Exchange Meeting"]

[Text] 1. Introduction

The Second Chinese Computer Security Technology Exchange Meeting was held on 9-13 June 1987 in Chengdu, Sichuan. This meeting was organized by Institute 706 of the Ministry of Aeronautical Industry and sponsored by the computer engineering society and applications society of the Chinese Electronics Society as a followup to the First Chinese Computer Security Technology Exchange Meeting held in Qingdao last July.

The 111 participants came from various ministries and committees in the Central Government, the PLA system, research and production organizations and higher learning institutions. Essentially, all major parties involved in computer security research and applications throughout China were represented.

Some 39 papers and reports were submitted, of which 34 were presented at the meeting. In addition to a general report, three special seminars on Rules for Computer Security Monitoring, Computer Security Technology Guidelines and Computer Site Security Requirements, and a special lecture on Formalization of Computer Security, were organized. In addition, in-depth discussions on suppression and shielding of electromagnetic radiation, network security and encryption technology, operating system and data bank security, and microcomputer security and disk protection were carried out in four separate groups.

2. Major Topics Discussed

A. Computer Security and Its Management

The security of the computer itself is to ensure that the computer can operate reliably so that information is not lost, leaked, or destroyed by

human or natural factors in the process of being gathered, processed, transmitted and stored. A series of security measures should be implemented with regard to equipment, facilities, environment and personnel.

B. Electromagnetic Radiation From the Computer and Shielding It

Just like other electronic equipment, a running computer and its peripheral equipment generate electromagnetic waves. The radiation from the video display device is particularly strong. It is possible to receive the signal from as far away as 1 km and restore the information.

C. Computer Software Security

Software security includes the security of applications software, operating systems and database management systems. Most computer crimes committed abroad involve the hacking of the software to destroy or penetrate the security of the system.

D. Security of Computer Information System and Database

Computer information system (including network) is the basic cell of a "computer society." Computer security not only involves the protection of highly secret data from leaking out but also the prevention of the computer information system that contains a great deal of unclassified data from breaking down.

E. Using Chinese Made Computers

From the security point of view, we must actively implement the policy of the State Council to use domestically made computers and should not blindly depend on imports. To the extent possible, we should choose a Chinese product if the specifications meet requirements.

3. Some Suggestions

All delegates unanimously agreed that computer security must be strengthened as computer development and applications move forward. Computer security not only directly affects whether the four modernizations can proceed smoothly but also affects the life and welfare of individuals, as well as the security of the nation. The delegates called upon the leadership to give this problem priority. We must implement measures from different angles such as legislation, organization and technology to gradually resolve existing problems. They suggested that:

(1) Experts and relevant departments be organized to draft a "Computer Security Monitoring Regulation" that is practical for the current situation in China so that we have rules to follow in computer security.

(2) Standards and technical specifications in computer security must be set up promptly so that they can be followed in the construction, maintenance and security of computer information and network systems.

(3) Various levels of computer security monitoring organizations must be set up immediately.

(4) Suppression and prevention of electromagnetic radiation is a pressing technical problem, especially in classified departments. Relevant departments should be organized to solve this problem in a short time based on such fields as standards, technology and equipment.

Security of Applications System

40080005 Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese 8 Sep 87 p 37

[Article by Lao Chengxin [0525 6134 0207]: "Security Technology in Computer Applications System"]

[Text] Computers are used in all lines of work in our society to greatly raise productivity and efficiency. However, if we do not fully understand its security problem, we may have to pay a high price which will affect the wide use of computers. Hence, computer security is one of the key issues concerning normal computer operations.

A. Concept of Security in Computer Applications

The security of a computer applications system is to prevent the leakage and sabotage of information. Information leaks involve the deliberate or accidental access of relevant information by a person. As information is being concentrated and the number of users grows, more users have access to the information in the system. The probability of information theft (by illegal means) also increases.

Information destruction includes accidental (such as due to hardware or software failure) and deliberate (sabotage) cases.

The use of improper methods to leak or destroy information belonging to others is a computer crime.

Computer security experts believe that there are four levels of security in a computer applications system. The first is legal and social management. Protection is rendered by national and local law, or by socially acceptable behavior. The second level of protection is the rules and regulations of the user organization under which the computer applications system is utilized, as well as the personnel structure and policy. The third level is physical protection. Fire and theft prevention technology is employed to limit unauthorized access to the computer. The fourth level of protection comes from electronics and programming. Hardware devices in the operating system, data files and application programs can offer protection by software techniques.

By adopting the appropriate security techniques, the probability of loss and destruction can be minimized, and if a security problem occurs, then the damage will be minimized.

B. Security Techniques To Prevent Information Destruction

1. Techniques To Improve Reliability of Computer Applications System

(1) System Design Redundancy

Redundancy is often required when the reliability requirement of the applications system is very stringent. One way is to use two computers, one as the current processor and the other as the spare. Once the processor is out of order, the spare is switched to work. The malfunctioning unit will be repaired and then placed in the system as a spare.

Based on relevant information, the reliability of a two-computer system can be derived from the following:

$$\text{stability time} = \left(\frac{(\text{MTBF})^2}{2\ (\text{MTTR})} + \frac{3\ (\text{MTBF})}{2}\right)$$

where MTBF is the mean time before failure and MTTR is the mean time to repair. If the MTBF for a single computer is 1000 hours and the mean time to repair is 10 hours, then the stable operating time for a dual computer system is over 5 years.

(2) Error Correcting Code Protection

For an incidental failure, a correcting code may rectify it. This is primarily used in storage.

(3) Restoration via Repeated Testing

Error detection code is used in all hardware, including the data communication circuit. When an error is found, the operation is repeated. The problem is resolved by either hardware or software means. If it is not eliminated after repeated testing, it is considered to be an inherent error. We will then immediately start the appropriate program to handle the failure.

(4) File Backup Technique

The contents of a file can be periodically updated and stored in duplicate in order to prevent the loss of information in an inherent failure. If the file is destroyed due to failure, it can be restored from the backup file. In a microcomputer system, backup copies are made on disks. Based on experience, at least two copies should be made; i.e., a total of three copies in existence.

One copy should be stored in the work station. The second copy should be locked in a fire-proof safe or other secured location in the office, but not in the same room as the computer. The third copy should be kept far away from the scene.

2. Computer Power Supply and Grounding Technique

In order to protect the security of the computer system from power failure, the following techniques are usually adopted:

Use of an uninterrupted power source, such as battery backup.

Use of a voltage regulated power supply.

Use of a circuit restricted power source, i.e., the circuit cannot be used with any noise generating equipment.

Use of a power failure interrupt system to monitor the voltage of the grid by hardware and software to ensure safety. When the voltage drops below a predetermined value, the interrupt device sends a signal to the computer to indicate a temporary cutoff of power. The computer immediately stops processing. The interrupt program steps in to preserve the status of the machine. After the power source becomes normal again, the device sends out another interrupt signal to automatically resume the operation.

Use of a good ground technique so that each computer is maintained at the same potential with respect to ground. The resistance should be less than 5 ohm.

3. Computer Environment

Better environmental conditions can improve the reliability of the computer. Generally, the requirements are:

Temperature range 18-24°C, relative temperature 55-65 percent, class 30000 clean room condition;

Shielded from electromagnetic radiation;

Preventive measures against fire, flood, earthquake and typhoon.

C. Security Against Information Leak

1. Data Encoding Technique

Information encoding is a way to prevent information from leaking out. It makes the program or data files difficult to understand for people who are not authorized to decode them. Information is encoded according to certain rules and then transmitted and stored. As long as the encoding rules remain secret, the information is effectively protected.

2. Data Compression for File Security

Data compression can be used not only to save storage space but also for security. There are many data compression techniques, the simplest being the zero elimination method. This technology includes eliminating zeros or space,

or both. In addition, there are more complex methods such as the format substitution method and Huffman code method.

3. Qualification Check

In order to prevent unauthorized access to information, the qualification of the requester may be checked. Only those who qualify can have access to the information. The common methods are:

(1) Password

Passwords are assig[illegible]sers on the system. A user must show his password to log on the syst[illegible] system checks the password and allows access only when the password ma[illegible]

(2) Program Authorization Level

The program is divided into several authorization levels. Certain subroutines can only be called, or certain commands issued, at above a certain level. When an unauthorized function is requested, the system will refuse the request. For instance, only the control program in the management system is allowed to directly implement input and output commands. When a user program issues input or output operations, it must rely on the control program. The control program, however, issues an input or output command only after the request is verified to be correct in order to prevent a user program from reading or updating any file.

(3) User Authorization Level

Just as in programs, users in a system are divided into several levels. For example, only specific users in charge of the management system can enter new users in the system.

User classification is given when users sign up. The system checks the authorization level when one enters the system.

Privacy Communication

40080005 Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese 8 Sep 87 p 53

[Article by Chen Feiyi [7115 7378 0001]: "A Scheme for Privacy Communication"]

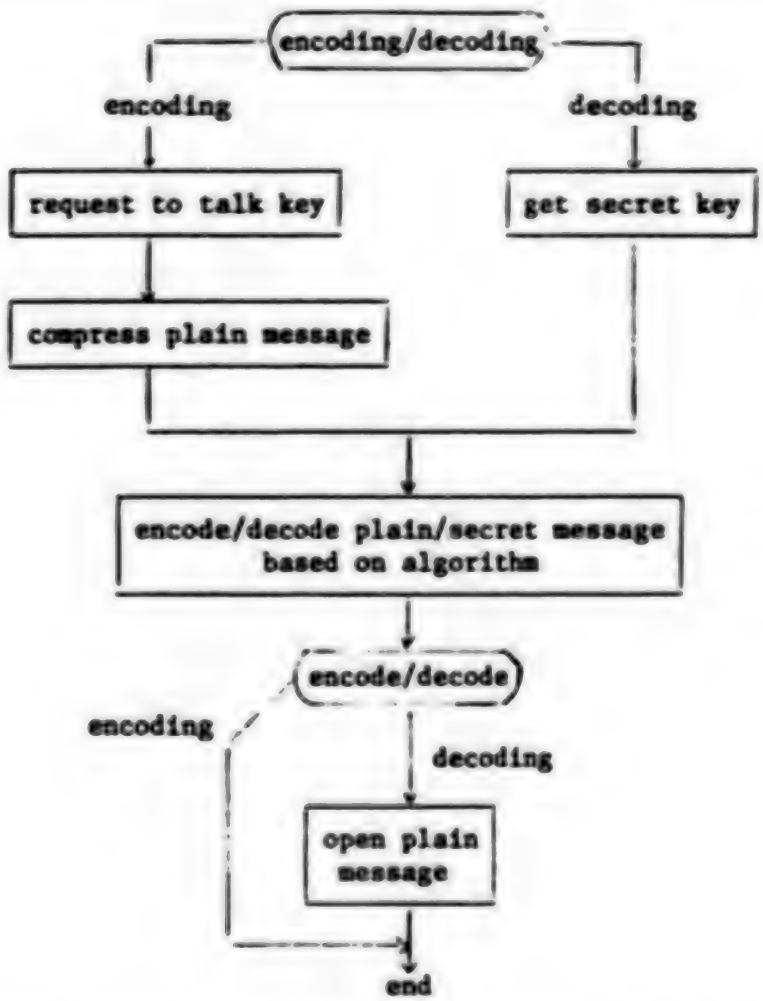
[Text] As computer networks become more popular and with the use of encryption systems, the computer communication era is here. Privacy communication is an important issue. This problem involves many aspects. This paper introduces a feasible scheme from the security of the computer network circuit. The data are encoded and decoded by software. The basic communication steps are as follows:

1. The person sending the message enters it in plain code on his terminal. After editing, the information is encrypted.

2. The coded message is transmitted in the communication network to the terminal of the addressee.

3. Upon receipt of the encrypted message, the addressee decodes it.

This software can simulate the encoding/decoding function of a modern encryption machine. It is usually a module in the presentation layer of the high level network protocol. The basic flowchart is as follows:



In some computer networks, the secret conversation key is generated by a central processing unit (CPU). This CPU is in charge of access control and secret key management. When a private conversation is about to begin, the host sends out such a request. The CPU checks out its authenticity and randomly assigns a key to both parties. This is the conversation key for encoding/decoding the data in the communication. Upon completion of the conversation, the key is invalidated.

It should be pointed out that the conversation key is an encrypted key. The basic key in the data network, however, changes periodically with time. The

conversation key is randomly generated. The only function of a basic key is to encode a conversation key. Since the randomly created conversation key can only be used once, it is a single use, random system.

The advantages of using software for encoding/decoding are low cost, flexibility and ease of modification.

The intensity of the code depends on the algorithm and the distribution and management of the key. In a computer network, a second code system can usually be added. Its function is to encrypt the access control and key distribution software. The encoding/decoding software may also be encrypted.

The following is an introduction to the second coding system.

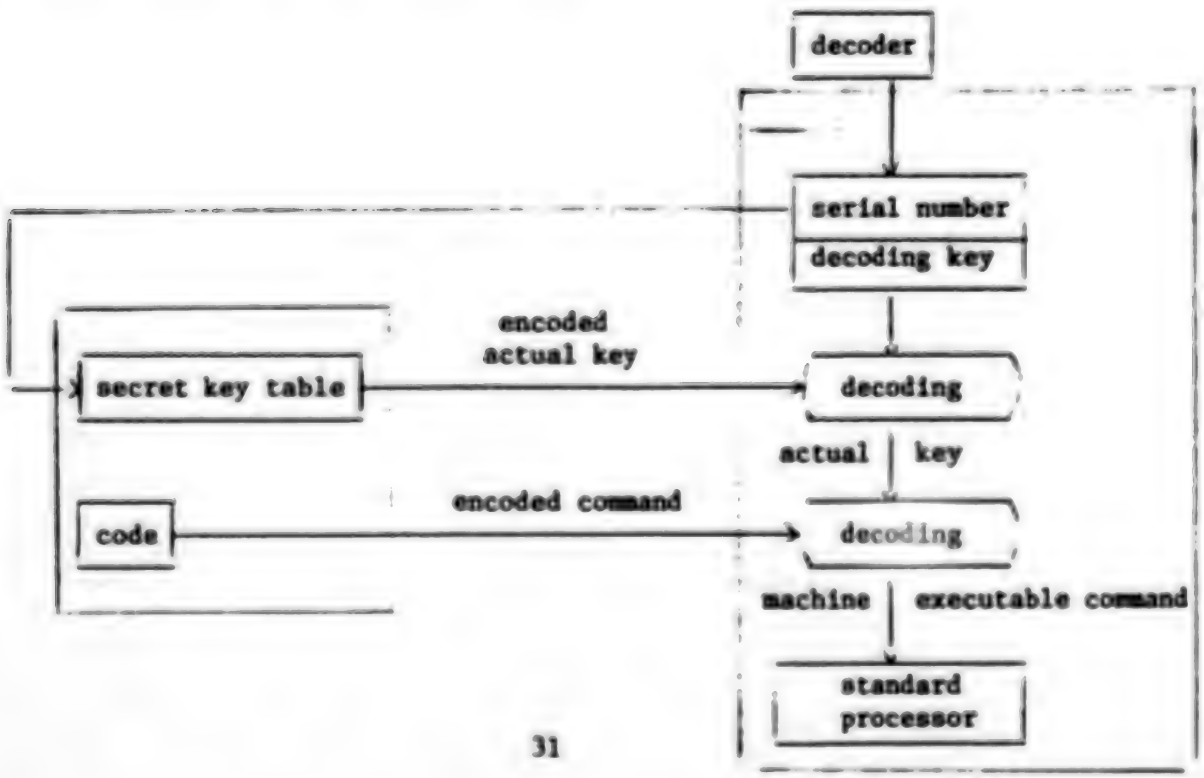
The system consists of encoding software and a decoding processor. The software was developed by a research institute and distributed to users on disks. The code is not readable by the users. It is executed by the decoding processor. A decoding processor is composed of a conventional processor and some functional components. They are:

1. Storage for the decoding key and serial number, which is not externally readable.

2. An actual register for the current key, which is also not externally readable.

3. Adding the following commands: a. install decoding key command; b. load actual key command; c. enter decoding mode command; d. quit decoding mode command; e. read serial number command; and f. encode command.

The block diagram for the encoding program is:



Each decoding processor has a corresponding pair of serial numbers and decoding keys. It is installed in the processor when the system is assembled. Before the system is assembled, it is necessary to run a program to generate its serial number, encoding key and decoding key. The serial number and decoding key are sent to the processor. The serial number and the encoding key are stored in a file called encoding key.

The developer of the encoding software can choose an actual key for every program. When the software is debugged, based on the principle of the secret key system, the encoding key corresponding to the user processor can be found in the file to encrypt the key. In the code generating part of the translator, a command to load the key register is executed to enter the specified key into the processor. After implementing the encoding command, the translator puts the encrypted key in the specified address.

A table listing all secret keys exists at the front of the software. It shows the serial numbers and the encrypted secret keys in different processors. When running encrypted software, its serial number must be taken out of the processor. As for encrypted keys, the load key register command must be executed before running in the processor decoding mode. Afterward, all commands are considered encrypted. The final command is to place the processor in its normal operation mode.

Because different serial numbers and encrypted keys were installed in the table when the program was installed, a copy of the encoding program can run on a number of processors. Once the decoding key of a processor is stolen, the serial number can be erased from the table to protect the software.

The second encoding system is used primarily to prevent the spread and hacking of the software. Obviously, we will lose some CPU time executing the encrypted software. Nevertheless, it is no longer a problem because of faster microcomputer processing speed.

Information Processing Equipment Leaks

40080005 Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese 8 Sep 87 p 56

[Article by Ye Laixi [0763 0171 0823]: "Leak, Theft and Suppression of Electronic Information Processing Equipment"]

[Text] As the use of microcomputer and electronic information processing equipment becomes more and more widespread, there are some real and potential threats, i.e., information leaks. This paper discusses the electromagnetic leakage of microcomputers, interception and cracking of leaked information, and its suppression.

I. Electronic Information Processing Equipment Leaks Information

In general, in the absence of external interference such as radio and television signals, it is possible to receive a clear and stable signal from the terminal without any special equipment from a distance of 100 meters.

Various microcomputers, printers, video monitors and Chinese character banks were measured with different instruments such as TR 4123, GBTR and SR-7 in the frequency range of 100 kHz to 1000 MHz. From 0.16 MHz to 400 MHz, very strong radiation comes from the internal memory of the CPU, I/O interface, clock, video, character bank, transmission line and power line. It is usually around 40 dBμV-60dBμV, and may reach a maximum of 75 dBμV. A frequency analyzer was used to analyze the wave form. Below 120 MHz, the pattern was obvious. At a distance of 100 meters, with a regular antenna, the signal intensity still reaches 30 dBμV.

Many electronic information processing devices leak out electromagnetic waves. By using these devices, the information processed will scatter into certain space. It is a big threat to security. Even in encrypted communication, prior to encoding or after decoding, the information is leaked into the surrounding space.

II. Hazard of Electromagnetic Leakage

The use of highly sensitive electronic surveillance instruments to monitor the electromagnetic wave leaking from a computer is timely, accurate, reliable, continuous and more concealed compared to other methods. It is difficult to detect. The information intercepted often covers a wide range, such as:

1. Political, economic and military information, as well as breaking the code with the aid of a computer;

2. Radiation from a microwave circuit to intercept long distance telephone calls;

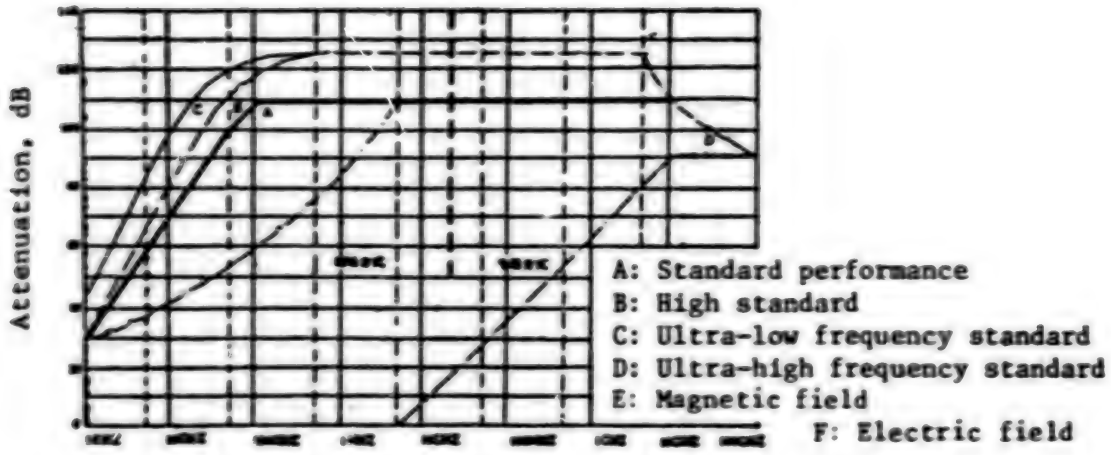
3. Electromagnetic leakage from a telephone or other electronic equipment to demodulate its content.

The electromagnetic radiation from a computer not only leaks information but also directly jeopardizes the security of the secret code. We know that modern encryption is done with a microprocessor. In the process, information radiates into the surrounding space. By actively detecting plain and coded information, it is possible to break the code, or even a higher level of code. In this case, the content can be obtained by intercepting an encoded document. Therefore, it is very dangerous to use a computer or electronic information processing device to process any classified information.

III. Suppression of Electromagnetic Leakage

(A) Use of a Metal Shielded Room

There are many plants manufacturing shielded rooms in China. They vary in quality and structure. The optimal parameters attainable by a shielded room are shown in the figure.



Maximum Attenuation Table for Various Types of Variable Field

The major products are:

Model P-22 double layer copper grid removable shielded room;

Model GP-1 single (double) steel plate removable electromagnetically shielded room.

The specifications of the two types of shielded rooms produced by Changzhou Computer Factory are listed below:

Model	Frequency range	Shield efficiency (dB)				
	(Hz)	10K	14K-200K	200K-1G	10G	15G
P-22	150K-1G	-	>70	>100	-	-
GP-1	10K-15G	70	95	100	100	87

Based on the leakage intensities of various computer and peripheral equipment at different frequency bands, both shielded rooms can meet the requirements. At a distance of 1 meter from the shielded room, the measured leakage from 100 kHz to 1 GHz was 0 dBuV. It should be pointed out that excellent ground must be installed since it is active shielding. It must be installed, used and maintained strictly according to specifications. For devices with intense low frequency or microwave radiation, requirements must be submitted to the factory directly.

Limitation of Metal Shielded Room: Some useful area will be sacrificed. It corrodes (rusts) easily and creates a contact problem, resulting in poor conductivity and reduced shielding effect. Furthermore, it is difficult to use, maintain and test.

(B) Systematic Shielding

It is more difficult to shield the equipment because it is impossible to systematically consider and select the design of internal circuits, I/O circuits, circuit layout, and components in order to reduce high frequency harmonics and to minimize parasitic and coupled circuits. Hence, it is very hard to achieve a high level of system-wide shielding. Only some remedies can be implemented. High level system-wide shielding must be done in the design stage.

1. China does not yet have any low radiation elements and components. Materials of high magnetic inductivity and high electrical resistance (10^8-10^{17} Ω/cm), such as Ni, Mn and Zn containing ferrite, are being developed to be sprayed (pasted) onto elements, components, covers and walls. The material may also be used on the surface of aircraft and missiles to absorb electromagnetic waves.

2. Use large LCD screen to replace CRT monitor to reduce video frequency radiation.

3. Use noise free typewriters.

4. Use a metal box or conductive sheet to cover areas of strong radiation such as the computer, monitor, printer and the character bank. Or, shield the entire system.

5. Take measures to isolate, shield and filter the power line and transmission line of a secured area from an unsecured area.

6. Use optical fiber or co-axial cables having good shielding characteristics as the power line and transmission line. Take the necessary steps to provide filtering for these lines.

7. Adopt a good grounding technique.

By implementing the above steps, good shielding effect can be obtained.

(C) Manufacturing Low Radiation Electronic Products

This is the ideal and most economical way to provide shielding overall. If China can produce electronic products reaching the TEMPEST standard in the United States, as well as highly effective shielded rooms with C^3I systems installed, then information security can be assured. It is a social problem. It must be organized and coordinated by various relevant parties to go through formulation of standards, product design, review, and verification to allow the TEMPEST technology to materialize in China. This is exactly what we hope will happen.

Computer Security Legislation

40080005 Beijing JISUANJI SHIJIE [CHINA COMPUTERWORLD] in Chinese 8 Sep 87 p 62

[Article by Ma Qiufeng [7456 4428 7364]: "On Computer Security Legislation"]

[Text] The development and popularity of computer technology brings progress and prosperity to society, and tremendous benefits and convenience to the people. In the meantime, because computer security is neglected, it also creates serious social problems. People depend on the computer more and more every day. The threat of the computer to our society is also becoming more serious. In developed nations, there are numerous computer crimes. In Japan, automatic teller machine crimes have grown 90-fold in the past 10 years. In countries such as the United States, there are considerable crimes committed by computer theft, fraud and corruption. The amount of money involved is usually significant. More seriously, the security of the country is also threatened. A great deal of classified central data is stored in various computer systems. A computer network is used for communication. Once the enemy steals any critical information, or disturbs this computer system, it will seriously jeopardize the security, and political and economic status of the nation. Because computer crimes are difficult to break and criminals are hard to convict, it is a low risk, high payoff type of crime. In China, we began to use computers late and they are not yet very popular. However, computer crime has already been discovered. Shortly after the Shenjun Branch of the Bank of China went online, computer fraud occurred. The prime culprit was the person in charge of the controller at the Shekou Branch. He used a loophole in the system to steal information and forged bankbooks. This was used by two other culprits to withdraw 20,000 yuan and 30,000 Hong Kong dollars at two other branches. In addition, tampering with computer-generated bankbooks and entrance examination grades also occurred. The trend is that computer crimes will grow. We must learn from the experience of other countries and address this issue seriously in order to ensure that computer applications will advance smoothly and healthily in China.

Measures are usually taken in three areas to strengthen computer security, and to strike at and prevent computer crimes, i.e., security technology, security management and legislation adjustment. First, we must improve the security of the computer. The higher it is, the less the probability of a computer crime. Security management of the computer must be strengthened. A rigorous management system must be formulated and implemented to drastically reduce the opportunity to commit a computer crime. Nevertheless, their effectiveness is limited. It is necessary to deter and punish the crime by law. Psychologically, the criminal mind is deterred. Computer crime is prevented and minimized by changing the social environment in which computers are used.

The characteristics of computer crime seriously challenged the conventional law. In other countries, numerous difficulties were encountered in dealing with computer crimes. Although the original code might apply to certain computer crimes, however, the interpretation is less than adequate and often requires some tactical explanation. The punishment is often not comparable

to the extent of the harm done. Since 1978, 46 out of 50 states in the United States have already passed state computer system protection or computer crime legislation. In 1984, the federal "Computer Fraud and Abuse Act" was passed. England, Japan and West Germany have also amended their criminal codes accordingly.

China does not have any computer security related laws and regulations. However, we should be prepared by learning from the experience of other nations. Computer security legislation can be divided into two categories. One is the administrative rules governing computer security technology and security management. The other is the law against crimes already committed. The Computer Security Monitoring Bureau of the Public Safety Department has already started drafting computer security monitoring regulations. The following is a list of opinions on the computer crime legislation issue.

1. Combine the foreign system and domestic situation.

China is very different from developed capitalist countries regarding the degree of socialization of computers, as well as in social and legal systems. We should treasure the experience gained in other nations. However, it should be seriously studied and cannot be adopted without any change.

2. Take an enthusiastic and prudent attitude.

Based on the present situation, China does not have a foundation to formulate a computer crime law. We should conduct a survey on computer crimes and computer legislation in the world. Theoretical investigation must be strengthened to serve as the basis for the relevant legislation.

3. Modify current laws and draft new special regulations.

As the first step, we can modify the present criminal code as a transition period to resolve the applicability of the law in order to accumulate some experience. As society becomes more computerized and S&T legislation advances, it may be necessary to pass special regulations against computer crimes.

4. Combine near-term and long-term legislation research.

The development of computer technology is just beginning. With the development and use of artificial intelligence, as well as the development of optical and biological computers, there will be new social problems. We must look into the future and be concerned with studying the relevant legal adjustments corresponding to the development trends.

5. Rationally ascertain the scope of computer security legislation.

We have to make sure that the healthy development of computer technology is not limited. It should promote, not hinder, the proper use of computers.

12553/6091

DESIGN AND IMPLEMENTATION OF DISTRIBUTED CHINESE CHARACTER DATA-BASE MANAGEMENT SYSTEM

40090015 Beijing JISUANJI XUEBAO [CHINESE JOURNAL OF COMPUTERS] in Chinese Nov 87 pp 593-601

[English abstract of article by Xie Li [6200 4539], et al., of Nanjing University]

[Text] Based on the centralized Chinese character data-base management system C-dBASE-II, a distributed Chinese character DBMS called DdBASE-II has been developed by adding concurrency control, communication commands, recovery mechanisms and security facilities. In this paper, the design and implementation of DdBASE-II are presented.

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CONCURRENT CONTROL ALGORITHM FOR DATA FLOW DATA-BASE MACHINE (DDM)

40090015 Beijing JISUANJI XUEBAO [CHINESE JOURNAL OF COMPUTERS] in Chinese Nov 87 pp 612-617

[English abstract of article by He Xingui [0149 2450 6311], et al., of Beijing Institute of System Engineering]

[Text] A concurrent control algorithm using a conservative time-stamp method for the data flow data-base machine DDM is presented. The algorithm is simple, efficient, deadlock-free and can be implemented easily.

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NEW METHOD TO STRENGTHEN SECURITY OF STATISTICAL DATA BASES

40090015 Beijing JISUANJI XUEBAO [CHINESE JOURNAL OF COMPUTERS] in Chinese Nov 87 pp 628-636

[English abstract of article by Shao Zuhua [6730 4371 5478] of Hangzhou Institute of Financial Managers]

[Text] A new method to strengthen the security of statistical data bases is presented. In this method, several changeable elements taking different values in some queries are placed in data bases. Therefore, compromising statistical data bases will be difficult. The method can be implemented easily, and will be more effective when used in conjunction with other protecting strategies.

9717

OVERVIEW OF COMPOSITE MATERIALS RESEARCH IN CHINA

40080002 Beijing LIXUE YU SHIJIAN [MECHANICS AND PRACTICE] in Chinese Vol 8 No 6, Dec 87 pp 2-4

[Article by Luo Zudao [5012 4371 6670] of Shanghai Jiaotong University as a speech give at the "International Conference of Composite Materials and Structures" held in Beijing 10-13 June 1986; assisted by Wang Zhenming [3769 7201 7686], Gu Zhenlong [7357 7201 7127] and Fan Fuqun [5400 6346 5028]: "Overview of Research and Development of Composite Materials in China"]

[Text] In the recent 6-7 years, there has been considerable enthusiasm about composite materials in the mechanics and materials community in China. However, composite materials research in China might be traced back to the late 1950's and early 1960's. As early as 1958, under the direction of the state Building Materials General Bureau a number of fiberglass reinforced plastic products were successfully developed and produced. At that time,the new material was given a new name--steel glass; glass as solid as steel. Since then, a great deal of progress has been made in the technology associated with the production of fiberglass composite materials. Furthermore, with improved technology, fiberglass projects have gradually expanded into a fairly wide range of fields. Because of continuously improving mechanical properties, fiberglass materials are widely used in a series of industrial equipment and engineering structures. Concurrently, our fiberglass products include high pressure oxygen cylinders, windmill blades, radar shields, propellers for small airplanes and small minesweepers. In addition, they are used to make certain instruments and components in a spacecraft, as well as some modern sports equipment such as the pole used in pole vaulting, bow and arrow,and racing yachts. Other items such as skiis and tennis and badminton rackets are made of carbon fiber reinforced materials. China has a respectable fiberglass industry, with three research institutes in Beijing, Shanghai and Harbin. The techniques include fiber winding, manual forming and molding. The manufacture of fiberglass cloth has advanced to unidirectional wool-free pre-soaked materials from plain weave cloth. However, up to now there has only been one type of product with a fairly narrow market. On the other hand, we still have quality control and standardization problems yet to be resolved and improved upon. In addition, the quantity of fiberglass and fiberglass cloth can still not meet the demand. It also falls far behind the amount produced in some developed countries. Advanced composite materials, especially carbon fiber manufacturing technology was developed in mid 1970. Since then, carbon fiber reinforced materials have

entered the aerospace industry. They are used to make some secondary parts such as vertical tail, cowling, and air brakes. In addition, there are honeycomb structured plates and shells. It is anticipated that the entire aircraft, including the fuselage and wings, will be designed to use carbon fiber composite materials to reduce weight and conserve fuel. Carbon fiber reinforced materials are replacing metals as the body of a rocket, and as components of a communication or weather satellite such as instruments supports and solar cell panels. However, the quality of the carbon fiber composite materials produced in China is of medium grade. Compared to the T300 made in Japan, they are only about 50 percent in both strength and rigidity. The best is only about 70 percent. The quality is also not very consistent. The performance specifications fluctuate significantly. Three-dimensional carbon-carbon composite materials can only be used as brake linings. These products are manufactured in small quantities. Contrary to other composite materials, the development of boron fiber composite materials is moving very slowly. This type of material is still in the laboratory in China. The development of metal-based carbon fiber composite materials also began in the early 1960's. However, significant progress in quality control has been made only in recent years. The SMC molding technique with short and mixed fibers is rapidly being developed. These SMC sheets are being used by the automobile industry as window frames and seats. Several years ago we developed several thermoplastics. In addition, a new product, Fanglun 1414, was developed. Its performance specifications are comparable to those of the famous KeVlar 29 made in the United States. This material has the same strength as fiberglass, but its rigidity is twice that of fiberglass. Other materials such as erosion-resistant fiber reinforced ceramics used for the space shuttle, and silicon carbide crystal are being developed and modified. In non-metallic based composite materials, resin is the most important matrix. Various resins manufactured in China have only medium quality. They lag far behind demand in both volume and varieties. We only produce a few types. Many important new products such as PEEK and TORLON have not yet been successfully developed. Finally, it should be pointed out that with the exception of fiberglass, the coast of producing these composite materials is very high. Therefore, they can only be used in the manufacture of items having special demand. In other words, the cost of carbon fiber composite materials and other advanced composite materials is so high that they do not have any commercial value. Therefore, the only widely used composite material is fiberglass. A small quantity of advanced composite materials is used in a few specialty products such as aircraft, spaceships, satellites and military applications. They are also used to make a limited quantity of sports equipment.

In summary, China's science and technology in composite materials, particularly advanced composite materials, lags behind in both quality and quantity, as well as in manufacturing techniques.

The Chinese government recently included the development of new materials as a key item in its national development plan. It is a priority item. It is anticipated that developing advanced composite materials will attract some attention. As a matter of fact, many government offices have already

encouraged and funded research institutes to work on composite materials. We plan to modernize production and use new technology. One way is to import new technology from other countries. For example, in the early 1980's, China bought the "Dolphin" helicopter production line from France. The entire structure is made of fiber reinforced composite materials. We have sufficient reason to believe that the manufacturing technology of composite materials will take off in the next several years. There is a chance that output will increase dramatically. Thus, the price will fall and the scope of applications will be fully developed.

Many scientists and engineers, including people working on material science, structural engineering, solid mechanics and chemistry, are interested in and enthusiastic about the study of composite materials. This has resulted in a large number of technical activities in the field.

Since 1980, organized and sponsored by three national societies (Chinese Society of Mechanics, Chinese Society of Aeronautics and Chinese Society of Astronautics), three national meetings on composite materials have been held. These have been held once every 2 years. The first meeting was held in the summer of 1980 in Beidaihe. Most attendants were scholars in the field of materials science. Two years later, the second national meeting was held in Harbin. The situation was quite different. Approximately half of the attendants worked as structural engineers or on solid mechanics. A tide of "composite materials" was thus formed. We expect more scholars attending the international meeting in Beijing and the fourth national meeting in Guangzhou at the end of 1986. In addition to schedules national meetings, meetings on composite materials are held by individual societies and local organizations. There are small scale meetings on the subject sponsored by various departments and committees. Symposium articles are published at each national meeting. copies of individual papers are also distributed at some small meetings. To date, there are several publications on composite materials. They are dedicated to printing academic papers on composite materials and their structures. Volume one of FUHECAILIAO XUEBAO [JOURNAL OF COMPOSITE MATERIALS] was published in 1984. Other journals such as FIBERGLASS REINFORCED PLASTICS AND COMPOSITE MATERIALS have been around for years. In addition, national journals, such as JOURNAL OF MECHANICS, MECHANICS AND PRACTICE, CHINESE JOURNAL OF AERONAUTICS AND ASTRONAUTICS and APPLIED MATHEMATICS AND MECHANICS, have also printed some papers in composite materials and mechanics.

In addition to the three fiberglass research institutes under the Building Materials General Bureau, we also have various research organizations, design institutes and research institutes under a number of ministries. For example, the Institute of Materials under the Ministry of Aviation Industry and the Institute of Materials under the Ministry of Astronautics Industry and the Institute of Mechanics under the Chinese Academy of Sciences are more or less engaged in the research of composite materials. In addition, research groups have been formed in many higher learning institutions by people from different disciplines. In general, the department of materials science in a university often has a special group on metallic or non-metallic based composite materials. Similarly, the same situation exists in mechanical engineering and engineering mechanics. We already have a fairly large rank of academic and technical professionals who are engaged in composite materials work.

Prior to 19780, the field of composite materials was a blank in many higher learning institutions. In recent years, many key universities in China have offered courses in composite materials, composite materials mechanics and anisotropic elasticity. Some are undergraduate elective courses, some are graduate courses and some are both. Other activities include short training classes, lectures and seminars. At the beginning, these courses chose mostly American textbooks. Since the courses have been offered for 3 to 4 years in some schools, most teachers use their own materials. The experimental aspect of the program is week in most schools because of a lack of equipment. For instance, only recently have we acquired the equipment to make unidirectional pre-soaked fabric and pressurized vessels. Nevertheless, with the encouragement of the Chinese Government, the number of research topics in composite materials funded by various departments is rapidly growing. The result is that all schools have trained quality graduate students. More and more people are studying composite materials. In addition, China has sent more than 30 visiting scholars abroad to study and engage in research of composite materials. We also invited many experts and scholars to lecture and give seminars in China. The experts include Professor Hayashi Ki of Japan, and Professors Cai Weilun, Sun Jinde, Sun Changzan, Jones and Kelly of the United States, as well as other scholars. The situation is quite different from that of a decade or two ago. The focus then was to concentrate the energy of a few scholars and engineers on manufacturing technology and applications. There is no doubt this is an important aspect. However, basic theory or basic and applied research has tremendous potential. It is a vital aspect in solving the problems today and providing the technology reserved for tomorrow. In reality, there are several technical problems, such as strength criterion, destruction mechanism and composite materials and their laminated structures, interface bonding between different media, waiting to be solved. Theoretically, such topics need to be further studied to break through some technical problems. The prospect of the research and development of composite materials in China is very good. This is because there are more young and qualified scientists and engineers joining us in this field.

In the symposium, everyone came to the understanding that at present in our country research on composite materials and their structures has advanced over a wide range of topics. The areas include delamination, dynamic impact, environmental impact, damage and destruction, hybrid fibers, thermoplastic composite materials, and metal-based composite materials.

In order to further push or technology forward and to make us competitive in the field among developed countries, we desperately need and welcome more international meetings to continuously exchange experience and new understanding in technology and in basic scientific theory. Many Chinese scholars have enthusiastically attended several Japanese and American meetings on composite materials. China has entered ICCM and will host the seventh ICCM meeting in 1989. This ISCMS meeting will be the first international composite materials meeting held in China. It is only a beginning, but a good beginning.

Since I do not know too much about composite materials, this speech is only a brief introduction to the status of the research and development of composite materials in China. I hope it is helpful. I would appreciate comments here on issues that are considered inappropriate or in error.

12553/12232

NUMERICAL AND EXPERIMENTAL RESEARCH ON PROPAGATION OF ELASTIC STRESS WAVES IN CONICAL SHELL UNDER AXIAL IMPULSIVE LOADING

40090019 Beijing LIXUE XUEBAO [ACTA MECHANICA SINICA] in Chinese Vol 19 No 2, Mar 87 pp 146-155

[English abstract of article by Chen Yuze [7115 5940 3419], et al., of Southwest Research Institute of Structural Mechanics, Chengdu]

[Text] The propagation of elastic stress waves in a conical shell subjected to axial impulsive loading has been studied by means of the finite element method and model experiment. Based on these results, in this paper it is shown that there are two axisymmetrical stress waves propagating with different velocities. One, produced by the membrane strain, is called the longitudinal wave, while the other, produced by bending deformation, is called the bending wave. Their attenuation along the surface of the shell is discussed. It can be found that the longitudinal wave and bending wave generated by reflection are coupled when a longitudinal wave impinges on the fixed boundary of the shell, and the two reflected waves will continue propagating with corresponding velocities separately in the structure.

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CUBIC SPLINE SOLUTION OF SYMMETRIC BUCKLING PROBLEMS OF CLAMPED SHALLOW SPHERICAL SHELLS

40090019 Beijing LIXUE XUEBAO [ACTA MECHANICA SINICA] in Chinese Vol 19 No 2, Mar 87 pp 179-185

[English abstract of article by Gu Shuxian [7357 3219 6343] of Lanzhou University]

[Text] Cubic B-spline approximations and iterative techniques have been used in computing highly nonlinear deflections of clamped shallow spherical shells under successive increments of uniformly distributed loads. The authors find that for the shells with the geometric parameter $\lambda > 5.5(\lambda^2 = \sqrt{12(1-\mu^2)}\,\frac{a^2}{Rh}$, $2a$ = arch chord length, R = radius of curvature, h = thickness), the slopes dP/dW_0 of p-W_0 (load-central deflection) curves may reach infinity (and become negative) before snap-through buckling loads have been attained. A special algorithm which alternately uses the increments of central deflection and load as iterative parameters has been developed to cope with this situation. This algorithm gives fairly good convergence rates for values of λ as high as 46, and the buckling loads obtained for $\lambda < 20$ are compatible with those computed by B. Budiansky and R. Archer using entirely different methods.

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FLOW-FIELD CHARACTERISTICS OF PRECOMBUSTION CHAMBER OF COFLOWING JETS WITH LARGE VELOCITY DIFFERENCES

40090020 Beijing LIXUE XUEBAO [ACTA MECHANICA SINICA] in Chinese Vol 19 No 3, May 87 pp 207-212

[English abstract of article by Wu Chengkang [0702 2110 1660], et al., of the Institute of Mechanics, Chinese Academy of Sciences]

[Text] A new type of precombustion chamber has been developed in which co-flowing jets with large velocity differences are used. A finite difference calculation procedure is developed for the calculation of this flow field. The computational results demonstrate the existence of the large recirculation regions. The effects of design parameters on the flow field are discussed.

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EFFICIENT METHOD FOR STRUCTURAL OPTIMIZATION

40090020 Beijing LIXUE XUEBAO [ACTA MECHANICA SINICA] in Chinese Vol 19 No 3, May 87 pp 246-257

[English abstract of article by Xia Renwei [1115 0086 0251], et al., of Beijing Institute of Aeronautics and Astronautics]

[Text] Based on the dual theory of a nonlinear programming method and the second order Taylor series expansions of functions, an efficient method for structural optimization is derived, which can be used to solve large-scale structural system problems with various kinds of behavioral constraints and can identify the set of critical constraints automatically at the optimum point. The formulas for computing the first and second derivatives of behavioral parameters expressed through element stress are also given. The expressions of the second derivatives and Hessian matrix can be significantly simplified using Saint-Venant's principle, and the efficiency of the optimization procedures can be further improved. Computational results for several typical examples show that the method presented in this paper performs satisfactorily in comparison with other computing techniques.

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NUMERICAL SIMULATION OF FLOW FIELD IN TITANIUM DIOXIDE REACTOR BY METHOD OF CHLORIDIZING AND OXIDIZING

40090021 Beijing LIXUE XUEBAO [ACTA MECHANICA SINICA] in Chinese Vol 19 No 4, Jul 87 pp 342-351

[English abstract of article by Zhao Guoying [6392 0948 4291], et al., of the Institute of Mechanics, Chinese Academy of Sciences; Wang Chongyue [3769 1504 1471] of China Tianjin Chemical Engineering Corporation]

[Text] A chemicophysical and fluid dynamic model is formulated for the numerical simulation of the process in a titanium dioxide reactor by the chloridizing and oxidizing method. Turbulence, species diffusion, chemical reaction and two-phase flow are considered in the model. The governing equations are solved using the SIMPLED algorithm which was devised by Partankar and Spalding. The flow temperature and concentration fields are obtained, giving us a clear picture of the chemicophysical and fluid dynamic processes in the reactor. The authors performed a careful investigation of the effect of wall heat transfer and chemical reactions on the flow. The results included in this paper can be used as a theoretical guide by engineers in their design of similar reactors.

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INVESTIGATION OF SIDE-WALL EFFECTS IN WIND TUNNEL WITH SUPERCRITICAL AIRFOIL TESTING

40090021 Beijing LIXUE XUEBAO [ACTA MECHANICA SINICA] in Chinese Vol 19 No 4, Jul 87 pp 381-386

[English abstract of article by Gao Chao [7559 6389], et al., of Northwestern Polytechnical University]

[Text] This paper presents an investigation of the side-wall effect in a two-dimensional transonic wind tunnel with side-wall boundary layer suction around the model. The span of the airfoil model used in the experiments is larger than the width of the test section. Therefore, the model can be shifted laterally and the streamwise pressure distribution for different spanwise sections can be obtained. The test results show that, for supercritical flow, the application of side-wall suction will result in an improvement of spanwise uniformity of aerodynamics and a downstream movement of the shock wave.

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WORK FINISHED ON MAIN ASSEMBLY OF CHINA'S FIRST HEAVY ION ACCELERATOR

40080013 Beijing RENMIN RIBAO (OVERSEAS EDITION) in Chinese 9 Sep 87 p 4

[Text] XINHUA, Lanzhou, 8 Sep—Work on the main assembly of China's first heavy ion circular accelerator now under construction in Lanzhou has been completed and its ion injector has been installed and debugged. The installation of the beam transporter and the eight experimental terminals has been stepped up. All construction should be completed by the end of 1988.

This large-scale heavy ion accelerator was designed by the Lanzhou Modern Physics Institute of the Chinese Academy of Sciences and includes the ion injector, the main accelerator, the beam transporter, and the eight experimental terminals, with the bulk of the assembly being made in China. The four magnetic rails are the largest of the parts with each weighing 500 tons.

According to the Lanzhou Modern Physics Institute, the main accelerator's magnetic field has been rated at 17.5 kilo-gauss.

All the main technical targets targets set forth in the design requirements have been met or surpassed.

An institute spokesman stated that after the completion of this large-scale heavy ion accelerator, not only will the needs of the Chinese Academy of Sciences be met, the facility will be made available to both Chinese and foreign scientists for experimental purposes.

/9274

DISSIPATIVE DRIFT INSTABILITIES IN HOT ELECTRON PLASMA

40090016 Beijing WULI XUEBAO [ACTA PHYSICA SINICA] in Chinese Vol 36 No 9, Sep 87 pp 1112-1121

[English abstract of article by Huang Chaosong [7806 2600 2646], et al., of the Institute of Plasma Physics, Chinese Academy of Sciences, Hefei]

[Text] Density-gradient-driven dissipative drift instabilities in a hot electron plasma are studied. A dispersion relation (including that of resistivity and viscosity) is derived. A hot electron ring can reduce the growth rate of the instability and anomalous transport flux. The stability condition for the drift wave is $\beta_h > 4\xi/(1+2\xi)$. The fluctuation levels and exciting region of the drift mode are measured, and the stabilizing effects of the hot electron ring observed. It is found that the experimental results are consistent with the theoretical prediction.

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POSSIBLE SURFACE ATOMIC STRUCTURE MODEL OF InP (100) (4x2) RECONSTRUCTION

40090016 Beijing WULI XUEBAO [ACTA PHYSICA SINICA] in Chinese Vol 36 No 9, Sep 87 pp 1148-1153

[English abstract of article by Hou Xiaoyuan [0186 2556 6678], et al., of the Surface Physics Laboratory, Fudan University, Shanghai]

[Text] The InP (100) (4x2) reconstructed surface prepared by argon ion bombardment and post annealing under phosphorus pressure has been investigated by LEED, HREELS and UPS. It was found by HREELS that the forming of surface In-H and P-H bonds during hydrogen exposure happened almost simultaneously. By measuring the UP spectra using polarized light sources, it can be verified that the dangling bond states of surface P atoms do not possess symmetrical characteristics with respect to the two basis vector directions of the surface unit mesh. It can be deduced from the above evidence that there must exist some In vacancies on the In-rich InP (100) surface, and the dangling bonds of those P atoms which are located next to the In vacancies orientate from their normal directions. The authors propose here a missing row-dimer model for the atomic arrangement of InP (100) (4x2) structures, which could explain the observed experiment qualitatively and might be used as a working model for seeking a precise surface structural model.

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CRYSTAL STRUCTURES AND MAGNETIC PROPERTIES OF $R_{13}Fe_{74}Si_{13}$ ALLOYS

40090016 Beijing WULI XUEBAO [ACTA PHYSICA SINICA] in Chinese Vol 36 No 9, Sep 87 pp 1177-1181

[English abstract of article by Hu Boping [5170 0130 1627], et al., of the Institute of Physics, Chinese Academy of Sciences]

[Text] Crystal structures and magnetic properties of $R_{13}Fe_{74}Si_{13}$ (R=Ce, Pr, Nd, Gd, Tb, Dy, Ho, Er, Y) alloys are investigated in this paper. The results show that $R_{13}Fe_{74}Si_{13}$ alloys have the pseudobinary intermetallic compound $R_2(Fe_{0.85}Si_{0.15})$ as the main phase instead of forming a ternary compound of the type $R_2Fe_{14}B$. The Si atoms probably substitute for Fe atoms in R_2Fe_{17} (9d site in Th_2Zn_{17} or 6g site in Th_2Ni_{17}). The Curie temperatures of $R_{13}Fe_{74}Si_{13}$ alloys are comparatively higher than those of R_2Fe_{17}. Saturation magnetization and magnetic anisotropy at room temperature are measured. Based on the results from extracting sample measurements at low temperatures, the variation of the magnetization of $R_{13}Fe_{74}Si_{13}$ with temperature is discussed.

9717

ULTRAFINE POWDERS PRODUCED BY U-V LASER PHOTOLYS OF IRON PENTACARBONYL

40090016 Beijing WULI XUEBAO [ACTA PHYSICA SINICA] in Chinese Vol 36 No 9, Sep 87 pp 1194-1198

[English abstract of article by Lin Jingu [2651 6855 6253], et al., of the Institute of Physics, Chinese Academy of Sciences]

[Text] Photodissociation of $Fe(CO)_5$ has been achieved using the U-V laser as the photolysis source. A middle-energy U-V laser pulse (~20 mJ/pulse) is directed into a specially designed gas cell which typically contains 10-20 Torr of $Fe(CO)_5$.

The authors have obtained some ultrafine powders from U-V laser photolys of iron-pentacarbonyl in the gas cell. Through the analysis of products using modern physical instruments, the authors identify the resulting powders as iron oxide and iron carbide; they also contain a little of the crystalline state of iron or carbon and oxygen. The particles in the powders are uniform in size (300-400 Å) and have catalytic activity.

At appropriate laser power densities, U-V laser photodecomposition of $Fe(CO)_5$ has also been achieved to produce Fe film on the window of the gas cell. The film composition has been examined by X-ray fluorescence.

9717

DIRECT DISPLAY OF ACCUMULATION OF SPACE CHARGES IN ONE-DIMENSIONAL IONIC CONDUCTOR α-$LiIO_3$

40090016 Beijing WULI XUEBAO [ACTA PHYSICA SINICA] in Chinese Vol 36 No 9, Sep 87 pp 1199-1202

[English abstract of article by Liu Jian [0491 6943], et al., of the Department of Physics, Nankai University, Tianjin]

[Text] The optical and electrical properties of α-$LiIO_3$ and its quasi-one-dimensional ionic transportation are closely correlated. A great deal of information on ionic transportation can be obtained by studying the optical and electrical phenomena. Here two experiments are designed and carried out. The authors have proved that the accumulated lines of space charges are produced by the interstitial lithium ions and cation vacancies, as are the bright lines of the grating which the authors recently reported as charge carriers. The whole growth layer is rich in positive charges. It is concluded that ionic tube transportation is identical to the accumulation of space charges.

9717

INVESTIGATION OF POLYCRYSTALLINE BORON AND BORON-CONTAINING METALLIC GLASSES BY SEELFS

40090016 Beijing WULI XUEBAO [ACTA PHYSICA SINICA] in Chinese Vol 36 No 9, Sep 87 pp 1213-1218

[English abstract of article by Fei Lu [6316 3873], et al., of the Modern Physics Institute, Fudan University, Shanghai]

[Text] The slow electron energy loss spectra in a reflection mode recorded above a core level, known as the surface extended energy loss fine structure (SEELFS), can give detailed local surface structural information of solids. This work reports for the first the the investigation of the role boron atoms play in polycrystalline boron, $Fe_{80}B_{20}$ and $Fe_{78.5}Si_5B_{16.5}$ samples using this technique. The oscillating structures are up to 300 eV above the boron K-edge. With the program developed in this laboratory, the radial distribution functions around the excited site have been obtained by analyzing the SEELFS data. After phase-shift correction, the nearest neighbor bond-lengths of the surface atoms have been found: 1.57 Å for polycrystalline boron, 2.14 Å for $Fe_{80}B_{20}$ and 2.12 Å for $Fe_{78.5}Si_5B_{16.5}$. Factors influencing the calculations are discussed and the total error has been estimated as 0.05-0.08 Å for central atoms with low atomic numbers. For the SEELFS spectra in the derivative mode, it is difficult to obtain other structural parameters, e.g., coordination number, factor of atomic disorder, etc. Therefore, another mode must be considered.

9717

SPLIT-COEFFICIENT MATRIX SOLUTION AND EXPERIMENTAL STUDY OF AXISYMMETRIC UNDEREXPANDED EXHAUST PLUMES

40090018 Mianyang KONGQIDONGLIXUE XUEBAO [ACTA AERODYNAMICA SINICA] in Chinese Vol 5 No 3, Sep 87 pp 226-234

[English abstract of article by Xie Zuyuan [6200 4371 3293], et al., of the National University of Defense Technology]

[Text] The space marching split-coefficient matrix method for solving the axisymmetric underexpanded exhaust plume flow field has been developed and tested, and the viscous/inviscid split method is used to treat the viscous flow. The color Schlieren photographs taken from experiments clearly show all the details of the flow field. The results agree well with the previous results in the near field, and are consistent with the results of the experiment in this paper in the far field. The numerical experiments reveal that the split-coefficient matrix method is much more stable and accurate than the central difference scheme since the shock and contact discontinuities can be captured correctly with little smearing or oscillation.

9717

THEORETICAL MODEL AND NUMERICAL SOLUTION FOR COMPRESSIBLE VISCOUS VORTEX CORES

40090018 Mianyang KONGQIDONGLIXUE XUEBAO [ACTA AERODYNAMICA SINICA] in Chinese Vol 5 No 3, Sep 87 pp 235-243

[English abstract of article by Lin Bingqiu [2651 3521 4428] of Beijing Institute of Aerodynamics]

[Text] Based on the dimensional analysis, the parabolic equation of a compressible viscous vortex core has been derived. A simpler numerical method described here can be used to calculate the subsonic, transonic and supersonic vortex motions. Numerical results for two examples are also shown here--one for the expanding motion of the stable vortex and the other for the contracting motion of the stable vortex.

9717

MIXED DIRECT-INVERSE PROBLEM OF TRANSONIC CASCADE

40090018 Mianyang KONGQIDONGLIXUE XUEBAO [ACTA AERODYNAMICA SINICA] in Chinese Vol 5 No 3, Sep 87 pp 244-250

[English abstract of article by Liu Wei [0491 5898] of Beijing Institute of Aerodynamics; Shen Mengyu [3088 1322 5148] of Qinghua University]

[Text] A computational method to solved the mixed direct-inverse problem of the transonic plane cascade is presented in this paper. A transonic plane cascade can be designed with desirable aerodynamic performance and reasonable strength characteristics by properly solving the mixed direct-inverse problem.

The method is based on the finite volume method. The blade surface and variables on the blade surface of the inverse problem region are successively corrected by the characteristic compatible equations.

The method presented in this paper solves the Euler equations directly so that it can deal with the flow field in which shocks exist. Compared with the transonic relaxation method, this method does not use irrotational assumption and can be applied in a wider range.

The method has been programmed and computed for several examples. The results are satisfactory.

9717

PARAMETRIC STUDY OF FLOW, TEMPERATURE AND SPECIES CONCENTRATION FIELDS IN PLASMA CVD CHEMICAL REACTOR

40090018 Mianyang KONGQIDONGLIXUE XUEBAO [ACTA AERODYNAMICA SINICA] in Chinese Vol 5 No 3, Sep 87 pp 251-260

[English abstract of article by Zhao Guoying [6392 0948 5391], et al., of the Institute of Mechanics, Chinese Academy of Sciences]

[Text] A theoretical investigation of the effects of different parameters on the flow, temperature and species concentration fields in a radio frequency plasma CVD reactor is carried out. The problems studied include the difference between hot and cold flow fields, the effects of the width of the side wall slot and the swirling velocity of the main flow on the flow. The results obtained for a Si_3N_4 reactor indicate that the flow, temperature and species fields are considerably altered by changes in these parameters.

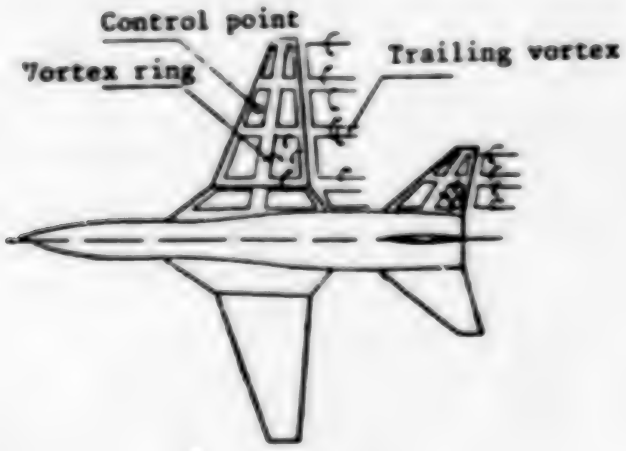
9717

INFLUENCE OF UNSTEADY AERODYNAMIC FORCES ON DYNAMIC RESPONSE OF VARIABLE SWEEP AIRCRAFT

40090018 Mianyang KONGQIDONGLIXUE XUEBAO [ACTA AERODYNAMICA SINICA] in Chinese Vol 5 No 3, Sep 87 pp 261-270

[English abstract of article by Yan Ming [0917 2494], et al., of Shanghai Jiaotong University; Qiu Chuanren [6726 0278 0088] of Shanghai Aircraft Institute]

[Text] A numerical method to obtain a complete solution for the dynamic response of a variable sweep wing aircraft while changing the angle of sweep is presented in this paper. Both aerodynamic and trajectory computations are included. During the flight of the sweptback angle variation, the aerodynamic forces acting on the aircraft are obviously unsteady, therefore, methods for computing these forces and accompanying responses of aircraft are also presented.



Computer Model

9717

ZERO-LIFT DRAG PREDICTIONS IN SUPERSONIC FLOW FOR COMPLEX CONFIGURATIONS

40090018 Mianyang KONGQIDONGLIXUE XUEBAO [ACTA AERODYNAMICA SINICA] in Chinese Vol 5 No 3, Sep 87 pp 293-297

[English abstract of article by Yang Qide [2799 0366 1795], et al., of China Aerodynamic Research and Development Center]

[Text] A supersonic zero-lift drag computer program for complex missile-like body shapes has been developed. A mixed method has been developed for wave drag prediction. At first, the supersonic Area-Rule concept is used to predict the drag of complete configuration and the drag of the main body. Then the interference factor is derived as the ratio of drag on the complete configuration to drag on the main body. Van Dyke's second order perturbation theory is used to compute the pressure distribution and resulting wave drag of the main body. The effect of the boundary layer on wave drag can be assessed by adding the calculated displacement thickness to the physical areas of the main body. Finally, the wave drag of the complete configuration is obtained by the product of the wave drag of the main body and interference factors.

The friction drag and displacement thickness of the main body are computed directly using Whitfield's method. The friction drag of the wing and fin and the base drag of the body are obtained from empirical methods.

Comparisons of the present results with experiments for some configurations indicate that 90 percent accuracy can be obtained for most conditions.

9717

SPHERICAL RESONANT CAVITY (II)--RAMAN OSCILLATION WITHIN SPHERICAL CAVITY

40090010 Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 7 No 8, Aug 87 pp 690-696

[English abstract of article by Qian Shixiong [6929 1102 7160] of the Physics Department, Fudan University, Shanghai]

[Text] The author makes a comparison between the spherical resonant cavity and the Fabry-Perot cavity. The Raman oscillation within the spherical cavity, including the oscillation spectra of water and ethanol droplets and the field distribution inside the droplets, is discussed in detail. Both the output resonance and input resonance were observed in the experiment and are discussed. The high-order Stokes oscillation and the combination Stokes oscillation in the liquid droplets were also observed. (Received 31 Jul 86; revised 27 Nov 86.)

9717

RECOVERY OF INTENSITY ENVELOPE OF ULTRASHORT LASER PULSES FROM EXPERIMENTAL CORRELATION DATA

40090010 Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 7 No 8, Aug 87 pp 697-702

[English abstract of article by Zhu Zhenhe [2612 2182 0735] of the Department of Physics, Central Nationalities Institute]

[Text] It is shown that the time-dependent intensity of an ultrashort laser pulse can be recovered from the second-order correlation $G^{(2)}(\tau)$ and the third-order correlation with single time-delay $G^{(3)}(\tau)$. A calculation method for recovering the intensity-enveloped I(t) is presented. The experimental data are successfully processed by a computer with new programming. A new instrument is suggested based on the determination of I(t) of an ultrashort laser pulse from correlation measurements. (Received 25 Aug 86; revised 25 Nov 86.)

9717

RELATIONSHIP BETWEEN OPTICAL TRANSFER FUNCTION AND NATURAL LIGHT FIELD IN SEA OR ATMOSPHERE

40090010 Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 7 No 8, ..ug 87 pp 707-713

[English abstract of article by Liu Zhisben [0491 2535 3234], et al., of the Department of Physics, Shandong College of Oceanography; Zhang Zhiming [4545 1807 7686] of the Department of Physics, Fudan University, Shanghai]

[Text] In this paper the relationship between the optical transfer function of seawater and the distribution of the natural radiance field in the sea is simply and directly determined based on the transform model of the sea radiance transfer. The variance of the angle spectrum of the sea radiance field is analyzed. A new simple method for estimating the distribution of the sea radiance field and measuring the optical transfer function of the seawater is proposed. The method is appropriate for the atmospheric circumstances. (Received 7 Jul 86; revised 17 Nov 86.)

9717

EVAPORATION CHARACTERISTICS OF ELEMENTS DURING VACUUM ARC REMELTING OF ALLOY A-286

40081067 Beijing JINSHU XUEBAO [ACTA METALLURGICA SINICA] in Chinese Vol 22 No 3, 18 Jun 86 pp B97-B104

[Article by Fu Jie [0265 2638], Hu Yaohe [5170 1031 0735], and Zhao Junhua [6392 0193 5478] of Beijing Iron and Steel Institute, and Zhao Yucai [6392 3768 2088] and Zhu Jainzhong [6175 1696 1813] of Shanghai No 5 Steel Works. Manuscript received 10 Dec 84: "Evaporation of Elements in Vacuum Arc Remelting of Large Cross-Section Consumable Alloy A-286 Electrode"]

[Text] Abstract: The melting characteristics and the Mn distribution at the electrode tip during the vacuum arc remelting of a 410 mm diameter consumable alloy A-286 electrode are investigated. It was discovered that Mn evaporation occurred primarily during the droplet formation stage at the tip. The distribution of Mn in the liquid phase is uniform and the content is close to the equilibrium level during evaporation. At the interface, the Mn content increases linearly from the liquid film to the electrode itself. It is believed that Mn evaporation is controlled by the migration rate of Mn in the liquid-solid two phase region. The Mn content in the remelted ingot can be expressed as

$$[Mn]_l = [Mn]_e \exp(-K_1 \cdot n\overline{A_d} \cdot \gamma \cdot W^{-1}) + [Mn]_f (1 - \exp(-K_1 \cdot n\overline{A_d} \cdot \gamma / W^{-1}))$$

Obviously, it is possible to control $[Mn]_l$ by controlling the Mn content in the electrode, $[Mn]_e$, and melting rate W. In addition, the condensed layer on the surface of the vessel was analyzed and found to be composed of Mn, Cr, Fe and Ni, with more than 40 percent Mn. The weight percentages for vaporized materials such as Cr, Fe and Ni essentially remained constant before and after remelting.

Little research is done on the evaporation behavior of elements in vacuum arc remelting. In reference [1], the evaporation kinetics of minute element Mg in the vacuum arc remelting of high temperature nickel alloys was studied under laboratory conditions. It proved that Mg evaporation primarily took place during the droplet formation stage. In addition, the formula controlling the Mg content in the remelted ingot was derived. This paper studies the evaporation kinetics of the principal element Mn in the vacuum arc remelting of an iron based high temperature alloy, A-286. Moreover, the evaporation characteristics of other elements were also investigated.

1. Research Method

The experiment was done in a 10 t vacuum arc furnace. The inner diameters of the water-cooled crystallizer are 423 and 506 mm and the consumable A-286 alloy electrodes are 343 and 410 mm, respectively. The tip of a flatly machined electrode was used to strike an arc at the bottom water tank. During remelting 506 mm diameter ingots, the operating current was 8000 A and the voltage was 24.5 V. Prior to terminating the operation, the current was 1500 A and the voltage was 21.6 V. The electrode tips were saved after the current was stopped in order to study the evaporation behavior of Mn in the droplet formation stage of the consumable electrode. In order to estimate the proportion of the Mn evaporated in the melted metal pool, the operating current in remelting 423 mm diameter ingots was 6500 A, the voltage was 24.0 V. Prior to the end, the current was 1500 A and the voltage was 21.5 V. The Mn distribution at the bottom of the ingot, i.e., the surface in direct contact with the water tank, the normal melted portion and the tip of the ingot, was measured. In order to investigate the evaporation characteristics of all elements in the remelting process, the composition of the condensate in the crystallizer and that of the remelted metal were analyzed. Based on the evaporation behavior of Mn in vacuum arc remelting, the control formula for the Mn content in the remelted ingot was derived.

2. Metal Melting Characteristics at the Tip of Large Cross-Section Consumable Electrodes in Vacuum Arc Remelting

During vacuum arc remelting of large cross-section electrodes, the metal at the tip of the consumable electrode melts in thin layers due to the direct current of the arc. The remelting metal layer drops down to form droplets. After a droplet reaches a certain size, it falls through the gap into the melted metal pool. Finally, it solidifies in a water-cooled crystallizer. Figure 1 [photo not reproduced] shows the morphology of the 343 and 410 mm diameter consumable electrodes as the process was terminated.

In order to study metal melting characteristics, macroscopic observation and metallographic analysis were used to examine the tip of the electrode. Figure 2 [photo not reproduced] shows the longitudinal macrographs of four droplets at the tip of a 410 mm diameter electrode. From Figure 2 we can see that the tip of the electrode can be divided into three regions, i.e., original electrode, remelted liquid metal and liquid-metal interface. This is similar to the vacuum arc remelting of small cross-section consumable electrode in the laboratory [1].

3. Mn Distribution in Electrode Tip and Remelted Ingot

3.1 Distribution of Mn in Various Regions at the Tip

In order to study the Mn distribution in various regions of the electrode tip, we did an Mn energy spectrum analysis on droplets 3 and 4 with a Model JSM-35C scanning electron microscope. The results are identical to those obtained by performing chemical analyses. Figures 3 and 4 show the results of energy spectrum analyses on droplets 3 and 4, respectively. The thickness of the

melted liquid layer (L) was determined metallographically. The position where each measurement was made was marked ahead of time. The thickness of the liquid-solid interface (L-S) was determined by the actual composition changes.

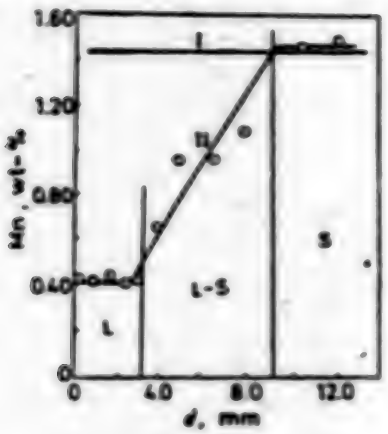


Figure 3. Mn distribution in various regions of droplet 3
I--Mn content of unremelted electrode; II--Mn distribution curve measured by SEM-EDS

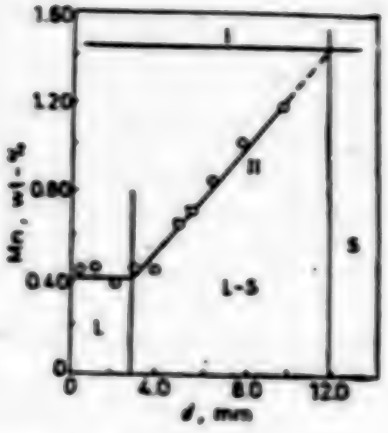


Figure 4. Mn distribution in various regions of droplet 4
I--Mn content of unremelted electrode; II--Mn distribution curve measured by SEM-EDS

From Figures 3 and 4 we can see that the Mn content in the liquid layer at the electrode tip is far less than that in the raw material, in analogy to the Mg distribution described in reference [1]. Within approximately 3 mm from the liquid solid interface, i.e., in the entire liquid metal layer, the Mn content is essentially uniform. It was approximately 0.40 percent in the experiment. This is different from the Mg distribution [1]. In the two phase region, from inside the liquid layer to the original material, the Mn content increases gradually to the original level in a linear manner. In the experiment, the two phase region was about 5-10 mm wide.

3.2 Mn Distribution in Remelted Ingot

The distributions of Mn in the bottom of the ingot, in the normal position (150 mm from the top of the ingot) and radially at the top of the ingot are shown in Figure 5. From Figure 5 we can see that Mn is not uniformly distributed radially. It is higher around the edge and lower in the center. The Mn content at the bottom of the ingot is basically the same as that in the normal melting position. It is lower at the top.

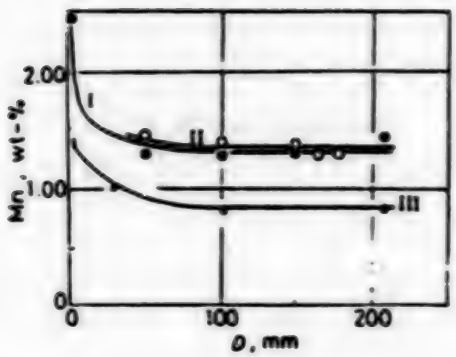


Figure 5. Mn distribution in remelted ingot
I--bottom; II--150 mm below top;
III--top

4. Mn Evaporation Kinetics in Vacuum Arc Remelting

4.1 Primary Mn Evaporation Position

The amount of Mn in the liquid layer is far less than that in the consumable electrode (see Figures 3 and 4). This suggests that a great deal of Mn vaporized at the electrode tip. This was determined by the experimental conditions. The results in Figures 3 and 4 were obtained at the end of the experiment. Compared to the normal remelting process, the current was lower prior to the end. The remelting rate was slower. The liquid metal stayed longer at the tip. Therefore, the Mn content is lower than that in a normal remelted ingot. On this basis, it is believed that Mn evaporation primarily occurs at the electrode tip.

In order to further pinpoint the primary evaporation location for Mn, it is necessary to compare the radial Mn distribution at the bottom to that in the normal remelting position of the ingot. Because the transition time of a melted droplet in the arc gap is very short in VAR and the lower water tank has a high cooling capacity, the droplets condense very rapidly. In this case, the composition of the liquid metal is considered to be very close to that of a droplet which just falls after evaporation. If Mn does not primarily evaporate from the electrode tip, the Mn content at the bottom should be higher than in the normal remelted region. The results shown in Figure 5 overturned this argument. If Mn evaporates primarily from the tip, the Mn contents should be very close. Figure 5 just proved this argument. This further proves that the proportion of Mn evaporation from the melted pool is very small.

Curve III in Figure 5 shows that the Mn content at the top is higher than those in the liquid layers, and higher than those in the remelted ingots, shown in Figures 3 and 4. This is due to the mixing of the Mn in the liquid metal prior to sealing the top (close to the Mn in the liquid layer) and the Mn in the melted pool in the normal remelting process (close to the Mn in the remelted ingot).

4.2 Limiting Steps for Mn Evaporation

The Mn evaporation process in the liquid metal layer and the solid-liquid interface includes the six steps described in reference [1] for Mg. Steps 3-6 are similar to that described in reference [1] and would not be limiting. As for the second step, from Figures 3 and 4 we can see that Mn is evenly distributed in the liquid metal and it is at the same level as that at the interface. This indicates that the mass transport of Mn in the liquid metal layer is very fast and it is not a limiting factor. In the two phase region, the Mn content varies linearly, indicating that the evaporation of Mn is limited by diffusion control of Mn atoms in the region. Step 1 is a limiting link.

It should be pointed out that Figures 3 and 4 were results obtained near the end. In the normal process, liquid metal stays for a shorter period of time at the tip due to higher current and remelting rate. The Mn content in the liquid metal layer might not be homogeneously distributed. Just as the Mg distribution described in reference [1], it is lower in the outer layer and higher in the inner layer. In this case, the evaporation process might be mixed controlled by steps 1 and 2. In deriving the kinetic equations, K_{12} should be used as the mass transport coefficient instead of K_1.

4.3 Control by Mn Evaporation Rate and $[Mn]_l$

When the Mn distribution is uniform in the liquid metal layer at the tip, the Mn mass transport flux is

$$J = K_1(C - C_f) \tag{1}$$

where J is the flux, K_1 is the mass transport coefficient limited by step 1, C is the weight of Mn per unit volume, C_f is the weight of Mn per unit volume in the interface which is the equilibrium volumetric concentration.

Equation (1) is expressed in terms of the evaporation rate:

$$-\frac{dC}{d\tau} = K_1 A_t (C - C_f) \tag{2}$$

where A_t is the surface area of the liquid layer at the electrode tip. Under a certain remelting process, there may be n droplets forming at the tip simultaneously.

$$A_t = \sum_{m=1}^{n} A_{d_m} = n\overline{A_d}$$

where A_{d_m} and $\overline{A_d}$ are the surface area of droplet m and the average area of the n droplets, respectively. C is converted into percent concentration and then rearranged into equation (2) as follows:

$$\frac{1}{[Mn] - [Mn]_f} d[Mn]dV = -K_1 n \overline{A_d} d\tau \tag{3}$$

where dV is the volume for a droplet. In the remelting process, the total liquid metal volume in the droplets changes from 0 to V (melted electrode or remelted ingot volume) and the Mn content varies from $[Mn]_e$ to $[Mn]_i$. (Here, to simplify the calculation, Mn evaporation in the arc gap and the liquid metal pool was neglected. The results shown in Figure 5 provided the experimental basis for this simplification.)

$$\int_{[Mn]_e}^{[Mn]_i} d[Mn] \int_0^V \frac{1}{[Mn]-[Mn]_i} dV = \int_0^\tau -K_1 \cdot n \bar{A}_d d\tau \tag{4}$$

$$[Mn]_i = [Mn]_e \exp(-K_1 n \bar{A}_d \tau V^{-1}) + [Mn]_f [1 - \exp(-K_1 n \bar{A}_d \tau V^{-1})] \tag{5}$$

$$[Mn]_i = [Mn]_e \exp(-K_1 n \bar{A}_d \gamma W^{-1}) + [Mn]_f [1 - \exp(-K_1 n \bar{A}_d \gamma W^{-1})] \tag{6}$$

where W is the average melting rate and γ is the specific gravity of the liquid alloy.

From equation (6) we see that:

1) $[Mn]_i$ increases with rising $[Mn]_e$ and decreases with lowering W. The Mn content in the remelted ingot, $[Mn]_i$, can be controlled through $[Mn]_e$ and W.

2) When $\tau = 0$ or $W \to \infty$, $[Mn]_i = [Mn]_e$. Mn does not evaporate.

3) When $\tau \to \infty$ or $W \to 0$, $[Mn]_i = [Mn]_f$, where $[Mn]_f$ is the equilibrium Mn concentration in weight percent. It is estimated based on the following:

Based on $[Mn] = Mn_{(g)}$, in equilibrium

$$[Mn] = \frac{p}{f_{Mn} \cdot p^0} \tag{7}$$

From reference [2] we know that

$$\log p^0 = \frac{-12280}{T} + 5.321 \tag{8}$$

The alloy composition (see Table 2 in this paper) and the values of e_{Mn}^j from references [3-5] were plugged into

$$\log f_{Mn} = \sum_{j=1}^{n} e_{Mn}^j [j] \tag{9}$$

to determine that $f_{Mn} = 1.143$ at 1570-1600°C. (The effect of individual element j is neglected when the value of e_{Mn}^j cannot be found.)

Considering that the surface temperature in the liquid metal layer at the electrode tip prior to the end would not exceed the liquid phase line temperature by much and that the vacuum in the remelting zone is of the order of Pa, we chose T = 1723-1773 K and p = 7Pa in the computation. Furthermore, it is assumed that f_{Mn} is 1.143 over the entire temperature range of choice. Then, $[Mn]_f$ = 0.37-0.23 percent.

From Figures 3 and 4 we can see that the Mn in the liquid metal is approximately 0.40 percent. It is close to $[Mn]_f$. It can be explained by the low current and slow melting rate prior to the end so that the liquid alloy stays longer at the electrode tip. Consequently, the Mn content in the alloy is close to the equilibrium level.

5. Evaporation Characteristics of Other Elements

In order to study the evaporation characteristics of other elements, a scanning electron microscope was used to perform energy spectrum analyses on the condensate layers adhered to the wall of the crystallizer. Table 1 lists the composition of the condensate. Table 2 shows the results of the chemical composition and gas analysis of the remelted ingot.

Based on the data in Tables 1 and 2, in the vacuum arc remelting of alloy A-286, elements such as Mn, Cr, Fe and Ni evaporate to various extents. The evaporated matter forms different condensate layers on the crystallizer wall. In this layer, the levels of Mn and Cr are higher than those in the remelted ingot. The Mn level is approximately 40 percent. The Fe and Ni contents are lower than those in the remelted ingot. The concentrations of Cr, Fe and Ni remain essentially the same before and after remelting. Further study is required to explain this phenomenon.

Table 1. Composition of Condensate Layer, wt-%

Ingot dia mm	Specimen code	Mn	Fe	Cr	Ni
355	105-00	41.85	29.10	24.81	4.24
	01	43.40	28.84	23.53	4.28
	02	44.69	27.36	23.85	4.30
	03	42.69	28.13	25.44	3.94
	1	44.00	27.69	24.02	4.28
	2	42.81	28.62	24.96	4.21
	3	43.80	26.48	23.14	4.67
423	107-1	42.11	29.28	23.82	4.79
	2	42.39	28.54	24.10	4.97
	3	48.02	25.09	21.54	4.75
	4	40.90	29.80	24.20	5.10

Table 2. Chemical Composition and Gas Content of Alloy A-286, wt-%

Heat No.	Alloy	C	Mn	Si	S	P	Ni	Cr
851	Consumable electrode	0.054	1.64	0.45	0.005	0.009	26.88	14.69
104	Remelted ingot,							
	dia 359mm	0.052	1.54	0.45	0.004	0.009	27.38	14.69
107	423mm	0.051	1.43	0.45	0.005	0.009	27.38	14.53
109	504mm	0.053	1.33	0.45	0.004	0.009	26.88	14.51

Heat No.	Al	Ti	Mo	V	N	H	O	Fe
851	0.19	1.91	1.28	0.29	0.0040	0.0007	0.0019	balance
104	0.18	1.87	1.28	0.29	0.0040	0.0001	0.0018	balance
107	0.19	1.91	1.28	0.29	0.0043	0.0001	0.0017	balance
109	0.20	1.94	1.28	0.29	0.0043	0.0001	0.0019	balance

The condensate composition analyzed can be used to explain the radial distribution of Mn in Figure 5. In VAR, Mn atoms evaporate from the liquid-solid interface at the tip of the electrode and condense on the wall of the water-cooled crystallizer. It forms a condensate layer with Cr, Fe and Ni which are vaporized at the same time. Due to the arc and the gas escape from the liquid metal pool which lead to metal splashing, the splashed metal and the condensate are combined to form the top of the ingot. As the level of the liquid metal pool rises, some of the metals in the ingot top are remelted. Mn diffuses toward the center so that radially the distribution of Mn is not uniform. Because the metal pool solidifies quickly, the Mn content becomes uniform at some distance from the crystallizer wall. In a 423 mm diameter ingot, the width of a high Mn content region is about 10-20 mm.

6. Conclusions

1. The evaporation characteristics of Mn in the vacuum arc remelting of a large cross-section consumable electrode were investigated. It was found that Mn evaporation takes place primarily during the droplet formation stage. When the melting rate is low, the Mn content inside the liquid layer is close to the equilibrium level of the evaporation process. In the solid-liquid two phase region, it increases linearly from the surface of the liquid metal layer to the original electrode material.

2. In the experiment, Mn evaporation is controlled by the migration rate of Mn atoms in the two phase region. The Mn content in the remelted ingot $[Mn]_i$ can be controlled by the Mn content in the electrode $[Mn]_e$ and the melting rate W:

$$[Mn]_i = [Mn]_e \exp(-K_1 \cdot n\overline{A}_s \cdot \gamma \cdot W^{n-1}) + [Mn]_s [1 - \exp(-K_1 \cdot n\overline{A}_s \cdot \gamma \cdot W^{n-1})].$$

3. In the VAR of alloy A-286, Cr, Fe and Ni also evaporate at the same time with Mn. The contents of Mn and Cr in the condensate are higher than those in the ingot. The situation is opposite with Fe and Ni. The Mn level is

greater than 40 percent. The proportions of Cr, Fe and Ni remain essentially unchanged before and after remelting.

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12553/6091

RAINBOW HOLOGRAPHIC IMAGE RECONSTRUCTED BY SPATIALLY EXTENDED WHITE LIGHT SOURCE

40090010 Shanghai GUANGXUE XUEBAO [ACTA OPTICA SINICA] in Chinese Vol 7 No 8, Aug 87 pp 721-728

[English abstract of article by Cai Luzhong [5591 1462 0022] of the Department of Optics, Shandong University, Jinan; Zhang Youwen [1728 1635 2429] of the Department of Applied Physics, Shanghai Jiaotong University]

[Text] It is well known that rainbow holograms can be reconstructed by a spatially extended (rather than a point) white light source. But this fact could not be explained by the available theories. In this paper, the authors propose a new concept, "the effective width of extended source," that can explain the above fact successfully. The effective width comes from two limiting apertures--the slit and the viewer's pupil. These two apertures make a rainbow hologram different from other holograms.

The effects of spatial and spectral extensions on the image point of the rainbow hologram were studied and proved to be approximately equivalent whether they existed separately or simultaneously. The resolution of the rainbow holographic image is derived for the spatial and spectral extended reconstruction source. Some reasonable conclusions are given. Obviously, these analyses are useful for further understanding the physical meaning of rainbow holograms, explaining some experimental phenomena, reducing temporal and spatial coherence requirements and choosing reasonable optical parameters in practice. (Received 7 Jan 86; revised 16 Feb 87.)

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MICROSTRUCTURE AND STRENGTH OF ALLOY GH37 AFTER LASER RADIATING SURFACE FUSION-SOLIDIFICATION

40090006 Beijing JINSHU XUEBAO [ACTA METALLURGICA SINICA] in Chinese Vol 23 No 1, Feb 87 pp A26-A32

[English abstract of article by Meng Qinglin [1322 1987 2651], et al., of Northeast Institute of Technology, Shenyang; Sun Tongkun [1327 0681 0981] of the Institute of Mechanics, Chinese Academy of Sciences, Beijing]

[Text] A study was made of the microstructure of alloy GH37 subjected continuously to CO_2 laser beams followed by various heat treatments. The influence of laser radiated local fusion-solidification and subsequent heat treatment on the microhardness over the heat-affected zone, rotating bending fatigue at 700°C and tensile and rupture strength at 800°C is discussed. For this alloy GH37, after fusion-solidification, further treatment to readjust the microstructure of the heat-affected zone is essential in order to properly precipitate the γ'-phase in carbide along the grain boundary, possibly reducing the element segregation in the dendrite over the fusion zone and eliminating the thermal residual stress, etc., thereby achieving temperature mechanical properties, e.g., rupture, tensile and fatigue strength, that are satisfactory. The appropriate heat treatment regime may include preheating and laser radiating at 1050°C, 4 h, A.C. + 800°C, 16 h, A.C.
(Paper received 23 Mar 85; revised 2 Sep 85.)

9717

THERMODYNAMIC CALCULATION OF M_s AND DRIVING FORCE FOR MARTENSITIC TRANSFORMATION IN Fe-Mn-C ALLOYS

40090006 Beijing JINSHU XUEBAO [ACTA METALLURGICA SINICA] in Chinese Vol 23 No 1, Feb 87 pp A42-A49

[English abstract of article by Zhang Hongbing [1728 7703 0393], et al., of Shanghai Technical College of Metallurgy; Xu Zuyao [1776 4371 5069] of Shanghai Jiaotong University]

[Text] The M_s temperatures of Fe-Mn-C alloys have been calculated by the application of the LFG model of $\Delta G^{\gamma\to\alpha}$ with Mogutnov's $\Delta G_{Fe}^{\gamma\to\alpha}$, Hsu-A model with Orr-Chipman's $\Delta G_{Fe}^{\gamma\to\alpha}$ and Hsu-B model with Orr-Chipman's $\Delta G_{Fe}^{\gamma\to\alpha}$, and are in good agreement with the experimental values. Through the mathematical treatment, the relationship between M_s and the composition of Fe-Mn-C alloys can be obtained as:

$$M_s(K) = 817.4 - 7513.4\chi_C - 4141.9\chi_{Mn} - 32083.5\chi_C\chi_{Mn}$$
(LFG model with Mogutnov's $\Delta G_{Fe}^{\gamma\to\alpha}$);

$$M_s(K) = 829.9 - 7580.5\chi_C - 4166.0\chi_{Mn} - 15727.8\chi_C\chi_{Mn}$$
(Hsu-A model with Orr-Chipman's $\Delta G_{Fe}^{\gamma\to\alpha}$);

$$M_s(K) = 829.2 - 7276.1\chi_C - 2915.4\chi_{Mn} - 43825.7\chi_C\chi_{Mn}$$
(Hsu-B model with Orr-Chipman's $\Delta G_{Fe}^{\gamma\to\alpha}$)

in which the linear correlation coefficient of these relations is larger than 0.992. Both C and Mn depress M_s linearly and the effect of C is almost twofold stronger than that of Mn. The introduction of an interaction term ($\chi_C\chi_{Mn}$) between the alloying elements in the present treatment shows that C and Mn mutually enhance their effects upon M_s. The driving force for transformation increases monotonically with C and Mn content and there is no singularity. The calculated M_s and the driving force largely depend on the $\Delta G^{\gamma\to\alpha}$ model and $\Delta G_{Fe}^{\gamma\to\alpha}$ values adopted. (Paper received 8 Mar 85.)

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LCF LIFE OF SUPERALLOY GH36 IN VARIOUS ENVIRONMENTS

40090006 Beijing JINSHU XUEBAO [ACTA METALLURGICA SINICA] in Chinese Vol 23 No 1, Feb 87 pp A76-A81

[English abstract of article by Wang Shuanzhu [3769 2633 2691], et al., of Xi'an Aero-engine Factory]

[Text] Studies have been made of the effect of various environments, such as the atmosphere, steam, marine impregnation and gas sputtering separately, or in combinations of them at both ambient and elevated temperatures, on the low cycle fatigue (LCF) life of an Fe-base superalloy GH36. Based on the observation of fracture behavior and an analysis of the scanning Auger electron spectroscopy on the fracture surface of the alloy, the cause of the LCF life affected by the environment is discussed. (Paper received 25 Mar 85; revised 11 Jun 85.)

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TECHNIQUE AND COMPLICATIONS OF ARGON LASER TREATMENT FOR ANGLE-CLOSURE GLAUCOMA

40091017 Beijing ZHONGHUA YANKE ZAZHI [CHINESE JOURNAL OF OPHTHALMOLOGY] in Chinese Vol 23 No 1, Jan 87 pp 1-6

[English abstract of article by Jin Jiachi [6855 1367 3589], et al., of the Chinese Academy of Medical Sciences]

[Text] A total of 228 eyes with angle-closure glaucoma (ACG) were treated with argon laser iridectomy alone or combined with argon laser peripheral iridoplasty. The success rate of penetration in the first session was 90.4 percent; useful iridotomies were made for all cases in one to three sessions; 7.9 percent of the perforations closed within 4 weeks after the operation, but were reopened by subsequent repetition of the treatment. The complications included corneal burns, iritis, localized lens opacity, transient elevation of intraocular pressure, etc. The authors summarize the experience of argon laser treatment for ACG and discuss the technique, parameters and minor complications of the procedure. The results show that the technique described is appropriate for Chinese ACG patients as a safe and effective method of treatment.

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ARGON LASER TREATMENT FOR PRIMARY OPEN-ANGLE GLAUCOMA

40091017 Beijing ZHONGHUA YANKE ZAZHI [CHINESE JOURNAL OF OPHTHALMOLOGY] in Chinese Vol 23 No 2, Mar 87 pp 75-81

[English abstract of article by Jin Jiachi [6855 1367 3589] of the Chinese Academy of Medical Sciences]

[Text] Twenty-nine eyes of seventeen patients with primary open-angle glaucoma refractory to medical therapy were treated by argon laser trabeculoplasty or combined with peripheral iridoplasty and followed up for an average of 10 months. The IOP was reduced by a mean of 9.7 mmHg, and those of 25 eyes (86 percent) were brought below 22 mmHg. The visual field improved in 85 percent of the eyes; the mean value of the facility of aqueous outflow improved 36.4-83.0 percent; the mean diurnal peak value of IOP was reduced from a pretreatment 26 mmHg to a posttreatment 19 mmHg. The results show that the laser technique used in this study was effective for Chinese patients, and that age, pretreatment IOP and the facility of aqueous outflow are closely correlated to the success rate. The authors recommend that cases not responding well to one or two kinds of drugs should resort ot laser treatment.

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REMOVAL OF EYELID BASAL CELL CARCINOMA WITH CO_2 LASER

40091017 Beijing ZHONGHUA YANKE ZAZHI [CHINESE JOURNAL OF OPHTHALMOLOGY] in Chinese Vol 23 No 4, Jul 87 pp 204-205

[English abstract of article by Liu Hengming [0491 1854 2494], et al., of Tongji College of Medicine]

[Text] Nine cases of eyelid basal cell carcinoma were removed with a CO_2 laser. All cases were confirmed by histopathological examination. Six of the nine cases were cured by one session of the laser treatment, while the other three cases were given a second session one month later to completely remove the residual tumor tissue. No recurrences occurred during follow-ups from 4 months to 5 years. The laser treatment is simple, safe and inexpensive, with few complications. It is particularly good for small and superficial eyelid basal cell carcinomas.

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PALPEBRAL AND CONJUNCTIVAL TUMORS TREATED BY HEMATOPORPHYRIN-LASER THERAPY

40091017 Beijing ZHONGHUA YANKE ZAZHI [CHINESE JOURNAL OF OPHTHALMOLOGY] in Chinese Vol 23 No 4, Jul 87 pp 206-208

[English abstract of article by Sun Xianli [1327 2009 7787], et al., of Tongren Hospital, Beijing]

[Text] Ten cases of carcinoma of the eyelid and conjunctiva were treated by the hematoporphyrin derivative (HPD) and laser phototherapy with complete or near complete disappearance of the tumor. HPD was administered intravenously in a dose of 3-5 mg/kg, and two days later the lesions were exposed to a laser beam of a wave length of 6320 Å and power density of 300-400 mW/cm^2. According to the authors' experience, the HPD phototherapy produced no harmful effects either locally or systematically. The authors recommend that for sebaceous cell carcinoma, which is a highly malignant tumor resistant to radiotherapy and chemotherapy, HPD phototherapy is of important therapeutic value.

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HISTOLOGIC STU.' OF ANTERIOR CHAMBER ANGLE OF RABBITS AFTER ARGON LASER IRIDECTOMY

40091017 Beijing ZHONGHUA YANKE ZAZHI [CHINESE JOURNAL OF OPHTHALMOLOGY] in Chinese Vol 23 No 4, Jul 87 pp 226-229

[English abstract of article by Jin Jiachi [6855 1367 3589], et al., of the Chinese Academy of Medical Sciences]

[Text] The anterior chamber angle in 36 eyes of 20 chinchilla rabbits were examined by light and electron microscopy at various intervals for a year following argon laser iridectomy. The results showed that the post-operative tissue debris and pigment granules were cleared from the anterior chamber through the following channels: (1) direct drainage through the trabecular spaces to the angular aqueous veins (equivalent to Schlemm's canal in humans); (2) phagocytosis by the endothelial cells of the trabecular meshwork; and (3) phagocytosis by macrophages on the surface and in the stroma of the iris. It was found that damage to the trabecular meshwork was transient and restored within 3 months of the operation, suggesting that the argon laser iridectomy is safe and that secondary glaucoma from occlusion of the outflow passage by pigment or debris fragments is unlikely.

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STUDY OF MODEL OF PARTICULATE MATTER POLLUTION OVER BEIJING AREA

40091015 Beijing HUANJING KEXUE XUEBAO [ACTA SCIENTIAE CIRCUMSTANTIAE] in Chinese Vol 7 No 2, Jun 87 pp 130-139

[English abstract of article by Wang Shufang [3769 3219 5364], et al., of the Department of Geophysics, Beijing University; Li Dianlin [2621 3329 2651] of Beijing Municipal Research Institute of Environmental Protection]

[Text] In this paper, the ADTL model has been modified for source height, particle diameter and wind velocity to calculate the diffusion of soot from chimneys. An empirical relationship between the observed data of raised dust and wind velocity has been adopted to estimate the contributions of surface raising dusts. Based on data analysis, a suggestion regarding the existence of unnegligible background dust near large cities is put forward to develop a new approach toward the calculation of total dust concentration. The results show a fairly good agreement between calculated and observed daily- and monthly-averaged dust concentrations.

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STUDY OF VIRAL POLLUTION IN YANGTZE RIVER, WUHAN

40091015 Beijing HUANJING KEXUE XUEBAO [ACTA SCIENTIAE CIRCUMSTANTIAE] in Chinese Vol 7 No 2, Jun 87 pp 231-236

[English abstract of article by Li Jin [2621 0513], et al., of the Department of Virology and Molecular Biology, Wuhan University]

[Text] Viruses in the Yangtze River were concentrated by the talcum powder-diatomite procedure. The infective virion's content was determined using the plaque technique, and the serotypes were identified by an enzyme-linked immunoadsorbent assay and SPA solid-phase immune electron microscopy. The results show that the detectability of viruses in the Yangtze River is 100 percent, with polioviruses I, II and III being detected. The infective virus content in the river water ranges from 1.2×10^2 to 1.7×10^3 PFU/L, and the content is higher during the summer and fall than during the winter and spring.

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AGKISTRODON ACUTUS VENOM HEMORRHAGIC COMPONENT ISOLATED

40081069 Hefei ZHONGGUO KEXUE JISHU DAXUE XUEBAO [JOURNAL OF CHINA UNIVERSITY OF SCIENCE AND TECHNOLOGY] in Chinese Vol 16, No 3, Sep 86 pp 317-322

[Article by Huang Wanzhi [7806 1238 3112], Wang Chun [3769 3196], Hu Erding [5170 0059 0002], and Lu Zixian [7627 1311 6343] of the Department of Biology, China University of Science and Technology: "Purification and Properties of a New Hemorrhagic Component From Agkistrodon Acutus Venom"; paper received 11 Nov 85; first four paragraphs are source-supplied abstract]

[Text] Abstract: A new hemorrhagic component, a designated hemorrhage-IV (AaH-IV), was isolated and purified from A. acutus venom by chromatography using DEAE-Sephadex A-50, Sephadex G-75, DE_{52} fibrinogen, and Sephadex G-100. It is a glycoprotein and has fibrinolytic and caseinolytic activities, but it does not have enzymatic properties as in arginine esterase. Its molecular weight is 51,000 and pI is 5.4.

Agkistrodon acutus is also known as "five-steps snake," subfamily Pallas pit viper. The venom of agkistrodon acutus is hematogenous. One of the main causes of fatality is the systemic hemorrhage in human and animal victims.

Hemorrhage from snake bite is probably caused by the increase in permeability of blood vessels as a result of the proteolytic properties of snake venom. As to the separation and purification of the hemotoxins from the agkistrodon acutus, there have been many prior efforts. A research group in Japan's Meijo University separated five hemorrhagic toxins from the agkistrodon acutus obtained from Taiwan, out of which four had lethal properties [1]. Xu Xun of our university purified three hemorrhagic toxins, all lethal, from the venom of the Wannan agkistrodon acutus [2].

This article reports yet another hemorrhagic toxin obtained from the venom of the agkistrodon acutus. Following the nomenclature of Xu Xun, it is named hemorrhagic toxin IV (AaH-IV), and its physical and chemical properties are explored.

I. Materials and Methods

1. Materials

Five-step snake venom, provided by the Anhui Qimen Snake Bite Institute. DEAE-Sephadex A-50, Sephadex G-75, Sephadex G-100 are products of Pharmacia, Switzerland. DE-52 fibrinogen is a product of Whatman Co., England. Standard protein is a product of Combithek, West Germany. Other reagents are from our country and are of analytical pure quality.

Instruments: LKB 2117 multi-functional electrophoretic instrument. SPECORD UVVIS double beam ultraviolet spectrophotometer, East Germany. 751 ultraviolet spectrophotometer, China. LKB chromatographic system.

2. Methods

(1) SDS polyacrylamide gel electrophoresis was used to measure molecular weights in accordance with Weber's [3] method, performed on the LKB2117 multi-functional electrophoretic instrument.

(2) Gel filtration was used to measure molecular weights in accordance with Lu Zixian's [4] method, using Sephadex G-100 chromatography. 0.15M NaCl was used in elution. N-acetyl-L-tyrosine ethyl hydrochloric acid and orchid dextran 2,000 were used to measure the volume of internal and external water content.

(3) Isoelectrofocusing was used to measure isoelectric pH values in accordance with Wrigley's [5] method.

(4) Staining and quantitative analysis of carbohydrates: periodic acid Schiff reagent was used in carbohydrate staining, staining time was about 12 hours. Quantitative analysis of glycolipids was measured with reference to Dubois' [6] method.

(5) Caseinolytic activity was measured in accordance with the Kunming Animal Institute's [7] method.

(6) Alkaline monoester phosphorase and diester phosphorase activity was measured in accordance with the Kunming Animal Institute's [7] method.

(7) Arginine esterase activity was measured in reference to Qi Zhengwu and others' [8] method.

(8) L-amino-acid oxidase activity measurement was measured with Tu Sile's reagent to measure the formation of ammonia.

(9) Phospholipase A activity was measured in accordance with Marinetty's [9] method.

(10) Coagulation activity was measured as follows. Human fibrinogen was placed in 0.1M pH7.4 Tris-HCl buffer to form an 0.4 percent solution, and

0.5 ml was then placed in small test tubes. 0.2 ml test samples were then added to the reagent and the time it took for clumps to form was noted.

(11) Fibrinolytic activity was measured using the fibrin plate method in accordance with Astrup's [10] method. The buffer used was 0.05M pH7.6 Tris-HCl.

(12) Hemorrhagic activity was measured as follows. Fur was removed from the back of rabbits. Test samples were injected intracutaneously. Sacrifice the animals in 24 hours and measure the size of blood spots and the degree of hemorrhage.

(13) Lethal activity was measured by abdominal injection of white mice with 20 ± 2 gm of toxin. The number of deaths was recorded in the ensuing 24-hour period. The LD50 number was calculated, and autopsies were performed.

II. Results

1. The Separation of Crude Toxin Extract

(1) DEAE-Sephadex A-50 chromatography. 2.0 gm of crude extract was dissolved in 10 ml of 0.02M pH8.0 Tris-HCl buffer. Insoluble matter was removed after centrifugation. The supernatant was added to DEAE-Sephadex A-50 column. The chromatograph is shown in Figure 1. The 12th component could cause hemorrhage and death in white mice.

(2) Sephadex G-75 chromatography. The above-mentioned 12th component was collected, dialysed and concentrated to suitable volume, and then added to Sephadex G-75 gel column. The chromatograph is shown in Figure 2. Only the first protein peak had hemorrhagic and lethal properties, but it is not an even component in electrophoresis.

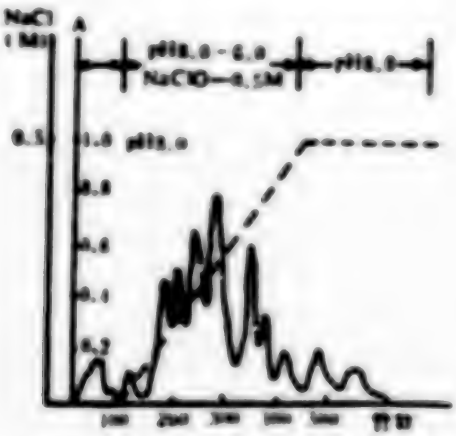


Figure 1. Crude toxin DEAE-Sephadex A-50 chromatograph

Column: 3.2 x 100 cm, quantity 2.0 gm, flow 24 ml per hour, collection of one tube number after 15 minutes. 0.01M Tris-HCl elution.
——A_{2809} -----NaCl concentration

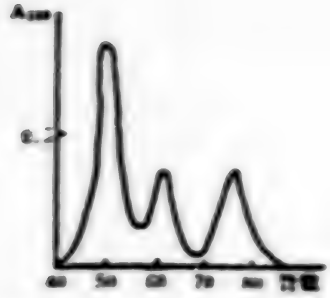


Figure 2. Crude toxin Sephadex G-75 12th peak chromatograph

Column: 1.8 x 100 cm, flow 12 ml per hour, collection of one tube number after each 20 minutes, saline solution.

(3) DE-52 fibrinogen chromatography. The above-mentioned first peak was obtained and then dialysed, chilled and desiccated. Then it was dissolved in 0.05M pH7.0, Tris-HCl buffer. The sample was added to DE-52 fibrinogen column. The chromatograph is shown in Figure 3. Both peaks had hemorrhagic properties, but peak I was stronger.

(4) Sephadex G-100 chromatography. The above-mentioned peak I was dialysed and concentrated to suitable volume, and added to Sephadex G-100 column. The chromatograph is shown in Figure 4. Hemorrhagic tests showed that peaks II and III had hemorrhagic properties. Peak II is SDS electrophoretically even. It is hemorrhagic toxin IV.

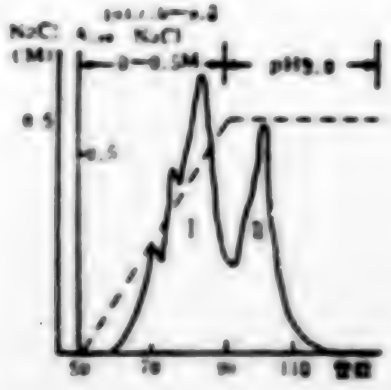


Figure 3. DE_{52} fibrinogen purification AaH-IV chromatograph

Column: 1.5 x 60 cm, flow 8 ml per hour, collection of one tube number after each 30 minutes, 0.05M Tris-HCl buffer.
———A_{2809} -----NaCl concentration

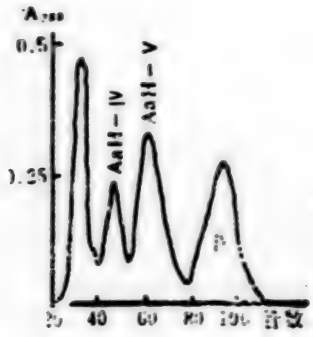
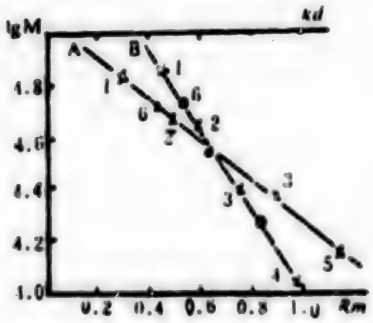


Figure 4. Sephadex G-100 purification AaH-IV chromatograph

Column: 1.5 x 60 cm, flow 6 ml per hour, collection of one tube number after each 30 minutes, saline solution.

2. Qualitative Analysis of Hemorrhagic Toxin IV

(1) Molecular weight. The molecular weight of hemorrhagic toxin IV determined by gel filtration and SDS polyacrylamide gel electrophoresis was 50,100 and 51,300 respectively. This is shown in Figure 5.



A gel filter, using Sephadex G-100 chromatograph, 0.15M NaCl solution
B SDS-polyacrylamide gel electrophoresis
1. bovine serum albumin
2. albumin
3. pancreatic protease
4. cell pigment C
5. RNA enzyme
6. AaH-IV

Figure 5. Molecular weight of hemorrhagic toxin IV

(2) Isoelectric point. The isoelectric point of hemorrhagic toxin IV was determined to be 5.4 by polyacrylamide gel isoelectrofocusing electrophoresis.

(3) Glyco-analysis. Hemorrhagic toxin IV was shown to be glycoprotein by analysis the gel band obtained from periodic acid - Schiff reagent staining AaH-IV polyacrylamide electrophoresis. The glycogen content was 4.4 percent.

(4) The determination of fibrinolytic activity. The maximal and minimal diameter of fibrinolytic regions on gel plates was used as an indication of the strength of fibrinolytic activity. The results are shown in Table 1.

(5) Various enzyme activity. Hemorrhagic LD_{50} measure; results can be seen in Table 2.

Table 1. AaH-IV Fibrinolytic Activity Strength

	Comparison (buffer)	AaH-IV
Standard plate mm^2	0	120

Note: AaH-IV concentration 0.2 mg/ml

Table 2. AaH-IV Enzyme Activity Overview

Item / Enzyme activity / Sample	Casein hydrolase	Amino acid esterase	Acid phospho-monoesterase and diesterase	Phospho-esterase A	L-amino acid oxidase	Coagulase	Hemorrhage	Fibrinolysin	LD_{50}
AaH-IV	+	-	-	-	-	-	+	+	5.7 mg/kg

III. Discussion

DEAE-Sephadex A-50 chromatography was used to separate agkistrodon acutus venom into 12 components. The 12th component was obtained for further separation and purification. The result was AaH-IV.

AaH-IV is a kind of hemorrhagic and lethal toxin. The results from autopsies of white mice showed that the abdomen and the intestinal tract both hemorrhaged, with signs of intestinal decomposition. This is probably because of the activity of fibrinolysin and proteolysin. Also, this is probably the main cause of death.

In comparison with the three hemorrhagic toxins purified by Xu Xun and others [2], it can be seen in Table 3 that AaH-IV is a new hemorrhagic toxin. It has been reported by Xu Xun that in addition to the discovery of toxins I, II, and III in the Wannan agkistrodon acutus, they also obtained another hemorrhagic component in one instance. The component did not possess proteolytic properties. On the other hand, AaH-IV appeared repeatedly and consistently during the separation process in many different samples, and also possess fairly strong proteolytic properties. Obviously the two are not the same component.

Table 3. Comparison of 3 Hemorrhagic Toxins Purified by Xu Xun and Others and AaH-IV

	AaH-I	AaH-II	AaH-III	AaH-IV
Molecular weight	22,000	22,000	22,000	51,000
Isoelectric point	4.6	5.3	greater than 9	5.4
Sugar content	-	-	+	+
Casein hydrolase energy	+	+	+	+
Fibro melt activity	+	+	+	+
LD_{50}	2.8 mg/kg	Same	Same	7.5 mg/kg

Note: LD_{50} - inoculation results in white mice abdomen

Mori and Sugihara [1] of Japan's Meijo University obtained five hemorrhagic toxins from agkistrodon acutus from Taiwan. In comparing AaH-VI that we discovered and their AC_3 there were similar qualities in the two. This is evident in Table 4.

Table 4. Comparison of Properties of AaH-IV and AC_3

	AaH-IV	AC_3
Molecular weight (SDS)	51,000	57,000
Isoelectric point	5.4	4.7
Sugar	+	+
Casein hydrolase energy	+	+
LD_{50}	150 mg/20 white mice	108 mg/20 white mice

These two components probably have the same properties. However, since the place of origin is not the same, and the experimental methods are not completely the same, it is easy to have certain differences. The qualities and properties of AaH-IV need further research.

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INHIBITORY EFFECT ON TOXICITY OF FUSARIUM TOXIN OF SELENIUM

40091016 Beijing HUANJING KEXUE XUEBAO [ACTA SCIENTIAE CIRCUMSTANTIAE] in Chinese Vol 7 No 2, Jun 87 pp 237-239

[English abstract of article by Peng An [1756 1344], et al., of the Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences]

[Text] The inhibitory effect of selenium on the toxicity of Fusarium toxin, which may be one of the factors causing Kaschin-Beck disease, is studied.

The strain of F. oxysporum NF 031 isolated from corn in the Kaschin-Beck disease region was inoculated on sterilized maize meal and incubated at 28°C for 15 days. The toxin was extracted by CH Cl and suspended in pure peanut oil. The tested mice were divided into three groups. Both the control group, injected with pure peanut oil (0.5 ml), and the second group, injected with 0.5 ml oil containing the toxin, were fed with tap water. The third group was fed with water containing selenium for two days prior to the toxic oil injection. All the mice in the second group died within one day, whereas those in the other two groups were still alive after 20 days, indicating that selenium might be a detoxicator of this toxin.

Using human embryonic cartilage cells, the damage to the cell by water extractable F. oxysporum toxin was studied. After two days incubation, the control group was continuously cultured in normal culture fluid while the test groups were incubated with the solution containing the toxin alone, selenium alone, or toxin and selenium. All experiments were carried out at 37°C for two days. A majority of the cells died in the culture solution containing the toxin alone, while the addition of selenium decreased the toxicity of the toxin.

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APPLICATION OF AVIDIN-BIOTIN-PEROXIDASE COMPLEX (ABC) METHOD WITH MONOCLONAL ANTIBODY TO HLA-DR ANTIGEN IN IMMUNOELECTRON MICROSCOPY

40091004 Beijing ZHONGHUA BINGLIXUE ZAZHI [CHINESE JOURNAL OF PATHOLOGY] in Chinese Vol 15 No 2, Jun 86 pp 87-89

[English abstract of article by Chen Bifen [7115 4310 5358], et al., of Fujian Medical College]

[Text] The monoclonal antibody (McAb) to the HLA-DR antigen was applied using the avidin-biotin-peroxidase complex (ABC) method to localize the HLA-DR antigen at the electron microscopic level. In four cases of B-cell malignant lymphoma and six lymphonodes from nontumor samples studied, sharply delineated electron dense products of the antigen and antibody complex were detectable on the outer B-cell membrane as well as the cell processes projecting outside. Electron-dense deposits were precipitated more heavily and irregularly on the surface of the B-cell tumor cells. The combined use of the anti-HLA-DR monoclonal antibody and the ABC procedure with paraformaldehyde fixation provides a simple and sensitive method for studying at the ultrastructural level the HLA-DR antigen-bearing cells which are vital to the immune response.

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PATHOLOGICAL OBSERVATION OF EXPERIMENTAL INFECTIONS BY COXSACKIE VIRUS B_4 (CVB_4) IN MICE

40091004 Beijing ZHONGHUA BINGLIXUE ZAZHI [CHINESE JOURNAL OF PATHOLOGY] in Chinese Vol 15 No 2, Jun 86 pp 110-113

[English abstract of article by Lin Jiuzhi [2651 0036 3112], et al., of the Capital Pediatric Institute]

[Text] NIH/Swiss sucklings, 5-7 days old, were infected with CVB_4. The results are as follows:
1) Systemic infection was observed in the infected mice, involving the myocardium, pancreas, skeleton, muscles, and fatty tissue. Characteristics of musculophilia and lipophilia were obtained in the pathological findings of these animal models.
2) Myocarditis was obtained as early as the third day after infection, reaching its peak on the seventh day. The recovery occurred gradually after the 14th day. Accompanying the fluctuation of titers of the inoculated viruses, the incidence of myocarditis varied from 17.6 to 31.7 percent.
3) The major pathological features of the viral myocarditis in sucklings were focal and massive necrosis of the myocardium. Calcification could occur as early as the third day after infection and inflammatory infiltration in the myocardium was relatively mild.
4) The pathological characteristics and the pathogenetics present in the pancreas and skeletal muscles, as well as their relationships to the clinical findings, are discussed.

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HISTOPATHOLOGICAL CHANGES IN ORGANS OF RABBITS WITH EXPERIMENTAL SHOCK INDUCED BY ENDOTOXIN OF E. COLI

40091004 Beijing ZHONGHUA BINGLIXUE ZAZHI [CHINESE JOURNAL OF PATHOLOGY] in Chinese Vol 15 No 2, Jun 86 pp 140-142

[English abstract of article by Huang Qifu [7806 0796 4395], et al., of Beijing College of Chinese Medicine]

[Text] Experimental shock was induced in rabbits by intravenous injection of endotoxin E. coli with a dosage of 5 mg/kg. All experimental animals showed a drop in blood pressure after administration of the endotoxin, and 67 percent of the shocked rabbits died within 9 hours.

Histopathological changes in the lung, liver, kidney and heart of 15 rabbits who died from the endotoxin shock were studied. The pathological changes in the lungs of the rabbits were the most obvious, including pulmonary edema, atelectasis, hemorrhage, microthrombus, mixed-thrombus and platelet-leukocyte microembolism.

The relationships among pulmonary injury, hemodynamics and platelet-leukocyte microembolisms are briefly discussed.

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REGIONAL ASSIGNMENT OF HUMAN ALCOHOL DEHYDROGENASE (ADH) GENE TO 4pter→4q21*

40101002 Beijing ZHONGGUO KEXUE [SCIENTIA SINICA (SCIENCE IN CHINA) SERIES B (CHEMICAL, BIOLOGICAL, AGRICULTURAL, MEDICAL AND EARTH SCIENCES)] in English Vol 30 No 7, Jul 87 pp 720-726

[English abstract of article by Xu Yiling [1776 0001 3781], et al., of the Institute of Genetics, Fudan University, Shanghai]

[Text] The hybrid clone FD1 constructed by fusion of the Chinese hamster cell line Wg3-h with human lymphocytes was irradiated with X-rays. Fourteen survival clones were isolated and three of them, F5B, F52B and F61A, were analyzed in detail by cytogenetic and biochemical methods. The results of chromosome G-banding followed by Giemsa-11 differential staining show that there exists a deleted human chromosome 4 in all of the three hybrids. This deletion of human chromosome 4 in F61A is 4pter→4q21. The results of isozyme analysis of phosphoglucomutase-2 (PGM2), which is located on 4p14→4q21, confirm the authors' cytogenetic conclusion. Polyacrylamide gel electrophoresis was used to study the alcohol dehydrogenase (ADH) in the human lymphocyte, Wg3-h and hybrid clones. Their electrophoretic pattern showed that the human ADH isozyme did express, in the peripheral blood lymphocyte, hybrids F5B, F52B, F61A and FD1. According to these results, the authors suggest that one of the Class I ADH structural genes is located on the human chromosome 4pter→4q21. Recently, McKusick reported that Class I ADH gene clusters had been assigned to chromosome 4q21→4qter. Considering this fact, the authors suggest that Class I ADH genes might be assigned to chromosome 4q21 or in its vicinity. (Received 28 Nov 85.)

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TOXIC PRINCIPLES OF BUPLEURUM LONGIRADIATUM

40091018 Beijing YAOXUE XUEBAO [ACTA PHARMACEUTICA SINICA] in Chinese Vol 22 No 7, Jul 87 pp 507-511

[English abstract of article by Zhao Jifu [6392 0679 4395], et al., of Shenyang College of Pharmacy]

[Text] Four new compounds of the polyenynic type were isolated from the ether extract of Bupleurum longiradiatum Turcz. (Umbellifarae) and were named bupleurotoxin, bupleuronol, acetyl-bupleurotoxin and bupleurynol. Bupleurotoxin and acetyl-bupleurotoxin are the toxic principles of Bupleurum longiradiatum Turcz. The LD_{50} for bupleurotoxin in mice (i.p. injection) is 3.03 mg/kg and for acetyl-bupleurotoxin 3.13 mg/kg.

Physical, chemical and spectroscopic evidence supports bupleurynol as heptadecatren-(2Z, 8E, 10E)-diyne-(4,6)-ol-1, bupleurotoxin as 14-hydroxyl-bupleurynol, acetyl-bupleurotoxin as 14-acetoxy-bupleurynol and bupleuronol as 14-carbonyl-bupleurynol.

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EFFECTS OF MONOCLONAL ANTIBODIES TO HUMAN PLATELETS ON ARACHIDONIC ACID METABOLISM

40091011 Beijing ZHONGHUA XUEYEXUE ZAZHI [CHINESE JOURNAL OF HEMATOLOGY] in Chinese Vol 8 No 7, Jul 87 pp 385-387,447

[English abstract of article by Wang Zhaoyue [3769 0340 6885], et al., of Suzhou Medical College]

[Text] SZ_2 and SZ_{21} are specific monoclonal antibodies against platelet membrane glycoproteins (GP) I and IIb/IIIa, respectively. Using a radioimmunoassay and a high performance liquid chromatography (HPLC), the authors measured the principal products of platelet arachidonic acid metabolism thromboxane (TX) B_2, 12-hydroxy-heptadecatrienoic acid (HHT) and 12-hydroxy-eicosatetraenoic acid (12-HETE), and studied the effects of these two monoclonal antibodies on the arachidonic acid metabolism. SZ_2 could selectively inhibit collagen-induced and restocetin-induced platelet arachidonic acid metabolism, and the inhibition was proportional to the concentration of the SZ_2. It seemed that the SZ_2 inhibited the receptor for factor VII on GPIb and also influenced the function of the receptor for collagen on GPIa. SZ_{21} inhibited the platelet aggregation induced by various activators. However, it did not inhibit the arachidonate metabolism. This phenomenon bore a resemblance to that of thrombasthenia, the platelet which lacked GP IIb/IIIa.

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PREPARATION OF MONOCLONAL ANTIBODIES TO HUMAN GROUP A AND GROUP B ERYTHROCYTE ANTIGENS AND ITS APPLICATION TO TECHNIQUES OF BLOOD GROUPING

40091011 Beijing ZHONGHUA XUEYEXUE ZAZHI [CHINESE JOURNAL OF HEMATOLOGY] in Chinese Vol 8 No 8, Aug 87 pp 449-451, 509

[English abstract of article by Tang Jiaqi [0781 1367 4388], et al., of the Military Medical Research Institute, Nanjing Command; Zhao Jinsheng [6392 6651 3932], et al., of the Nanjing Red Cross Blood Center]

[Text] This paper deals with the preparation of monoclonal anti-group A and anti-group B antibodies and its application to blood grouping. By means of the fusion of SP2/0 mouse myeloma cells and spleen cells from BALB/c mice immunized with a mixed suspension of group A and group B erythrocytes, the authors established five hybridomas which secreted saline agglutinating antibodies to red cells. All five hybrid cells have stably secreted antibodies for 6 months. Identification with routine blood grouping tests, agglutination-inhibition tests and absorption-elution tests showed that among the five hybrid cells, H2, H5 and B7 secreted special anti-A antibodies and D5 secreted an anti-B antibody. Using the avidity test to detect the avidity of the McAbs and comparing these results with those of anti-A and anti-B sera, the authors found that the avidity of the 4McAbs was higher than that of human anti-A and anti-B sera. After being diluted with a protective agent, the stability of the McAbs was satisfactory. Applying the blood grouping tests with both antibodies, McAbs and human anti-A and anti-B sera to examine 1782 blood samples from donors and 58 cord blood samples from newborns, the results were identical.

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IDENTIFICATION OF ADENOVIRUS TYPES BY MONOCLONAL ANTIBODIES

40091019 Beijing ZHONGHUA YIXUE ZAZHI [NATIONAL MEDICAL JOURNAL OF CHINA] in Chinese Vol 67 No 8, Aug 87 pp 441-443

[English abstract of article by Lu Jirong [7627 4949 2837], et al., of the Bethune Medical College]

[Text] Five hybridomas secreting monoclonal antibodies against adenoviruses were prepared. Among them, one secreted group-specific antibodies against adenoviruses, two secreted type-specific antibodies against adenoviruses, two secreted type-specific antibodies against adenovirus type 3, and the other two secreted type-specific antibodies against adenovirus type 7. High specificity was confirmed by a specific test. Using the immunoperoxidase histochemistry technique, 59 strains of adenoviruses were identified. The positive corresponding rate was from 48.0 percent to 100 percent when compared with the neutralization test, and the negative corresponding rate was 100 percent. This was related to the genotype. This technique is simple and easy. Results can be obtained in 2-4 hours and are easy to judge without background color. Various genotypes can also be discovered using this technique, which will probably replace the tedious neutralization test in the near future.

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EPIDEMIC HEMORRHAGIC FEVER--CLINICAL ANALYSIS OF 1,333 CASES

40091012 Beijing ZHONGHUA CHUANRANBING ZAZHI [CHINESE JOURNAL OF INFECTIOUS DISEASES] in Chinese Vol 5 No 3, Aug 87 pp 133-136, 132

[English abstract of article by Liu Zefu [0491 3419 1381], et al., of the Department of Infectious Diseases, Second Affiliated Hospital, Fourth Military Medical College]

[Text] Different aspects, including clinical features, dates of routine tests, rate of atypical lymphocytes, results of immunological examinations and changes in hemorrheology, blood gas, radiorenography and nailfold microcirculation, etc., were analyzed for 1,333 cases of epidemic hemorrhagic fever. The cause of death and disadvantageous factors of prognosis were also studied. Of the 1,333 patients, 55 died. The average mortality was 4.12 percent, however, the mortality of cases treated in 1983-1984 was reduced to 1.85 percent. The authors point out that effective treatment is closely related to early diagnosis, early rest and early treatment. Attention should be paid to the main complications, which include shock, renal failure and hemorrhage.

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PROSPECTIVE STUDY OF SEROLOGICAL DIFFERENTIATION BETWEEN ACUTE AND CHRONIC HEPATITIS B

40091012 Beijing ZHONGHUA CHUANRANBING ZAZHI [CHINESE JOURNAL OF INFECTIOUS DISEASES] in Chinese Vol 5 No 3, Aug 87 pp 143-145, 142

[English abstract of article by Wang Jianxiang [3076 0256 5046], et al., of the Department of Epidemiology, Shanghai Medical University]

[Text] Sixty-one patients with positive IgM anti-HBc, clinically diagnosed as "acute hepatitis B," were prospectively studied. Among them, 28 (45.9 percent) were IgG anti-HBc negative at the onset of illness identified as primary acute hepatitis B and 24 were followed up for 8-17 months. HBsAg disappeared and SGPT returned to normal in all 24 cases; 19 (79.2 percent) developed anti-HBs and the remaining 5 (20.8 percent) had anti-HBe. On the other hand, 33 (54.1 percent) were IgG anti-HBc positive at the onset of illness identified as chronic hepatitis B with previous HBV infection. Of these, 24 were followed up. All 24 cases were persistently positive HBsAg, and 8 (33.3 percent) had clinical recurrence of the disease. Therefore, the detection of specific IgG and IgM anti-HBc is of great significance in the serological differentiation of acute hepatitis B with primary infection from chronic hepatitis B with previous infection.

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CLINICAL APPLICATION OF ANTI-LIVER SPECIFIC LIPOPROTEIN MONOCLONAL ANTIBODY

40091012 Beijing ZHONGHUA CHUANRANBING ZAZHI [CHINESE JOURNAL OF INFECTIOUS DISEASES] in Chinese Vol 5 No 3, Aug 87 pp 146-148

[English abstract of article by Chen Guangming [7115 0342 2494], et al., of the Scientific Research Laboratory, Guangzhou Hospital of the Air Force]

[Text] In the authors' laboratory, two anti-liver specific membrane lipoprotein monoclonal antibodies (anti-LSP McAb) were prepared and used for the determination of an anti-LSP antibody in patients with hepatitis B. For this purpose, a double antibody sandwich ABC-ELISA technique was developed, and the results have been compared with those of other methods, such as the indirect technique, ELISA and PHA. Altogether, 277 patients with various types of hepatitis B were studied. The positive rates in the cases of chronic active hepatitis (CAH) and chronic persistent hepatitis (CPH) were 91.7 percent and 50 percent, respectively (by the double antibody sandwich technique), and 9.17 percent and 56.2 percent respectively (by the indirect technique). Both were significantly higher than results obtained by ELISA and PHA methods ($p < 0.05$ or 0.01). The positive rate of anti-LSP in the case of CAH was higher than that in either type of hepatitis ($p < 0.01$ or 0.05). At the same time, the levels of anti-LSP in the serum of patients with SLE (kidney injury type) and chronic nephropathy were also studied. The positive rates were 15.4 percent and 17.8 percent, respectively (by double antibody sandwich technique). These results were obviously lower than those obtained by the indirect technique (46.2 percent and 62.2 percent, $p < 0.05$).

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PLASMA LEVELS OF BLOOD COAGULATION FACTOR XIII SUBUNITS IN VIRAL HEPATITIS

40091012 Beijing ZHONGHUA CHUANRANBING ZAZHI [CHINESE JOURNAL OF INFECTIOUS DISEASES] in Chinese Vol 5 No 3, Aug 87 pp 149-151

[English abstract of article by Sun Jiaqiang [1327 1367 1730], et al., of Shanghai Municipal Infectious Diseases Hospital; etc.]

[Text] By means of electro-immunodiffusion, plasma levels of blood coagulation factor XIII subunit a antigen (XIII-a:Ag) and subunit b antigen (XIII-b:Ag) were measured in 21 normal subjects and 103 patients with various types of viral hepatitis. Levels of both plasma XIII-a:Ag and XIII-b:Ag decreased significantly in all types of patients. In addition, the more severe the disease, the lower the plasma levels of XIII-a:Ag and XIII-b:Ag were. Seven of the patients died. Their average levels of plasma XIII-a:Ag and XIII-b:Ag were 29.8 percent and 44.7 percent, respectively, which were lower than those of other patients. The results showed that a quantitative estimate of XIII-a:Ag and XIII-b:Ag is of diagnostic and prodiagnostic value.

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OBSERVATION OF INTRACELLULAR CYCLIC NUCLEOTIDE LEVELS OF PERIPHERAL LYMPHOCYTES IN PATIENTS WITH VIRAL HEPATITIS

40091012 Beijing ZHONGHUA CHUANRANBING ZAZHI [CHINESE JOURNAL OF INFECTIOUS DISEASES] in Chinese Vol 5 No 3, Aug 87 pp 155-157

[English abstract of article by Li Mengdong [2621 1125 2639], et al., of the Department of Infectious Diseases, Xinqiao Hospital, Third Military Medical College]

[Text] In 32 healthy blood donors, the intracellular cAMP and cGMP levels of peripheral lymphocytes and the cAMP/cGMP ratio were 2.301 ± 1.107 pmol/10 cells, 0.064 ± 0.024 pmol/10 cells and 38.92 ± 26.71, respectively. The intracellular cAMP and cGMP levels in patients with both acute and chronic active viral hepatitis were increased, and the cAMP/cGMP ratio was significantly decreased. In those patients with chronic active hepatitis who were treated with glucocorticoids, neither an increase in cAMP nor a decrease in cGMP was detected. Therefore, it was hard to prove that a therapeutic effect of glucocorticoids in vivo was achieved through its anti-inflammatory and immunosuppressive activities.

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S&T STRUCTURAL REFORMS PROMOTED

Reform Leading to Legislation

40080088 Tianjin KEXUEXUE YU KEXUE JISHU GUANLI [SCIENCE OF SCIENCE AND MANAGEMENT OF S&T] in Chinese No 6, Jun 87, p 1

[Article by Yu Meisun [0205 2734 5549] and Wu Chengren [0702 2110 0117]: "S&T Structural Reforms Should Break a Path for S&T Legislation"]

[Text] The Seventh Five-Year Plan is an important period for China to carry out system reform. China's economy has already begun to shift gradually from the past reliance mainly on direct control by administrative methods towards primarily indirect control. Under the new conditions, in such areas as cross-region, cross-industry, cross-department and cross-ownership system agriculture, industry, commerce and production, supply and marketing, some good tendencies of multi-form and multi-level cooperation and association have been displayed and a great many very vigorous and complex lateral economic linkages have appeared. At the same time, central cities are further expanding domestic and foreign economic technical cooperation, importing foreign capital, opening markets: technology markets, financial markets, and labor markets. In future system reform, even more new situations and things will appear and more problems will be produced. Thoroughly resolving these new problems is the key to the continuing advance of reform of the system.

In this process, a situation of parity confrontation of new and old systems, new and old ideas will unavoidably appear: original economic systems, traditional ideas, and work methods are not suited to part of the development of productivity forces, some aspects have already been changed, some are being reformed, and there has not been time to change some; part of the economic activity has begun to shift to new operational tracks but another part has not yet left the original tracks. This type of situation has now appeared: new systems, new ideas, and new methods are playing a role so that the economy has been invigorated, but at the same time, many problems have appeared and if they are not resolved, the function of the new system may be lost. Thus measures must be adopted to eliminate these problems, among which some old ideas, methods, and measures must be used to resolve the problems which have newly appeared, but in practice and their defects. This vanishes and that grows, this grows and that vanishes, and this result frequently has an impact on invigorating the economy and the smooth conduct of reform. At the same time, such basic economic relations as prices,

finance, banking, and wages have not yet been smoothly regulated and we are not yet good at effectively using economic means and a complete system of laws has not yet been established. Daily it is clear that the present state of legal system construction has not caught up with the demands of the development of the situation.

These phenomena indicate that for a long time we will be limited by old ideas of the legislative sections--legislation is the regularization of the current range of behavior and the summary of successful policy and experience, the law follows practice--without fully understanding the leading nature of economic legislation, so that construction of the legal system cannot catch up with the pace of the invigorating of China's economy and reform practice, a backward phenomena will appear. For example, since the structural reform of science and technology, it has been demanded that science and technology be oriented towards economic construction, research results should be converted into socially productive forces more rapidly, but the legal question of science and technology personnel holding two posts has not yet been resolved, and some people have even been taken to court. Since limits of legal stipulations are lacking, many problems are frequently reviewed and handled within units very differently. Thus, legislation is urgently needed and legal means must be used to safeguard the interests and initiative of science and technology personnel. From this it is clear that as the reform progresses, on the one hand it is smashing various fetters which do not conform to development of productive forces and at the same time some non-economic obstacles which some people did not envision have appeared and will continue to appear. There is no way for all these problems to be resolved relying solely on economic workers. Workers in political science, law, sociology, psychology and natural sciences must cooperate closely across disciplines and departments. Comrades of economic law sections should study and research issues of reform of the economy and the science and technology system, should participate in decision making and implementation of reform of the economy and the science and technology system, so that reform can promptly use legal means to carry out readjustment and control. Comrades of research and consultation departments on reform of the economy and the science and technology system should study and research legal issues and should participate in legislative activity, so that the legislation can serve reform more directly and accurately. Reform of the system and the establishment of the legal system must be complementary and the reform of the science and technology system must open the way by science and technology legislation.

State Council's Role in Reform

40080088 Tianjin KEXUEXUE YU KEXUE JISHU GUANLI [SCIENCE OF SCIENCE AND MANAGEMENT OF S&T] in Chinese No 6, Jun 87, pp 2-3

[Article by Zhu Chuanbo [2612 0278 2672]: "Directions, Opportunities, Conditions; Study the State Council's 'Certain Stipulations on Further Promoting S&T Structural Reforms'"]

[Text] This paper discusses the understanding of studying the State Council's "Certain Stipulations on Further Promoting S&T Structural Reforms" from the aspects of the management functions of scientific research agencies, organizational structure of the science and technology system, channels of scientific research expenses, scale of scientific research agencies, intensified scientific research agency reform, and relaxing and invigorating management of science and technology personnel and discusses the difficulties of reform.

In the two years since the implementation of "Decision of the Central Committee of the Chinese Communist Party Concerning S&T Structural Reforms", preliminary results have already been achieved. However, the dislocation of scientific research and production has not been fundamentally turned around. The organizational structure of the science and technology system has not yet moved, and many scientific research agencies are still affiliates of government departments, and the problem of many science and technology personnel being excess has not yet been fundamentally resolved. To change this situation, especially to adapt to the intensively developing new situation of economic system and political system reforms, and to promptly intensify the S&T structural reforms, the State Council issued "Certain Stipulations on Further Promoting S&T Structural Reforms" (below, "Stipulations"). Here we will discuss our understanding of studying the "Stipulations".

I. The "Stipulations" further indicate the direction of reform.

The "Stipulations" were based on the primary question which exists in S&T structural reform today and points out the direction of reform in a well aimed way. It amounts mainly to the following:

First is pointing out in terms of the political management functions that departments of the State Council should carry out separation of political and research responsibilities, simplify administration and relax authority and gradually shift scientific research agencies downward to enterprises, enterprise groups, industries and central cities--changing from direct control to indirect management by the state in the management of scientific research agencies.

Second is pointing out that in terms of the organizational structure of the science and technology system scientific research agencies which are engaged in product development should be a part of an enterprise or an enterprise body and take different forms such as, developing into technical development centers, becoming regional technical development and service centers, becoming scientific research forerunner type enterprise bodies, forming technical project contract companies, or becoming scientific research and production type enterprises. Realize lateral association of scientific research and production at multiple levels and in multiple forms promotes the close integration of science levels and in multiple forms promotes the close integration of science and technology and the economy by resolving the separation of scientific research agencies and enterprises, the dislocation of research, design, education and production, and the isolation of military and civilian, departments, and regions.

Third is pointing out that in terms of channels of scientific research expenses accelerating reduction of scientific research costs, future scientific research agency start up expenses should be recovered primarily from the enterprise or from enterprise sales totals or the primary source should be enterprise and enterprise service income. Implement multiple channels and multiple raising of funds for scientific research expenses in order to resolve the problem of scientific research agencies feeding on the state or science and technology personnel feeding on the research institute.

Fourth is pointing out that in terms of the scale of scientific research agencies' retrenchment will no longer increase the scale of agencies or personnel. Realize purification of the science and technology ranks in order to resolve the problem of some research institute levels being low and some research institutes having too many personnel.

Fifth is pointing out in terms of intensifying scientific research agency reform and strengthening the orientation of scientific research agencies towards economic vitality, the rights of scientific research agencies should be separated from economic management rights, scientific research agencies which are of small scale or which have poor management can try out leasing or contract management, large academies and institutes can be divided into small economic accounting units or into enterprise and enterprise groups or collective and individual contracts.

Sixth is pointing out in terms of relaxed and invigorating science and technology personnel management to have planned organization or permit and support some science and technology personnel to leave the scientific research agency or institution of higher learning through some method such as transfer, leave or resignation and go to small towns and rural areas to accept contracts or manage medium, small, and rural enterprises, set up and manage technical development, service and trade agencies using various types of ownership, create medium and small-scale jointly funded enterprises of various types, and permit those science and technology personnel who can lead the people to become well off begin to prosper first. Smash the rigid science and technology personnel management system which has taken shape over the past decades, liberate productive forces and create broad opportunities and good social environment for the growth, development and broadening of talent.

II. To implement the reform direction it is necessary to master the opportune moment for reform.

Pointing out the blueprint for reform is undoubtedly important for broadening people's field of vision and strengthening confidence in reform. However, how it should be started and what transitional measures, i.e., the so-called "phase pattern", are adopted in the process of reform are of critical importance. If it goes beyond the degree permitted by current objective conditions and there is insistence on doing future or next step things with the "ultimate pattern" as the reform target of the current phase, then it may be difficult to increase the pace of reform. Thus, the emphasis of

reform work should be firmly placed in research and discussion of the actual reform steps, "the target pattern" of the present phase should be taken out and transitional measures for continuing advance should be formulated. Only in this way can we find the "rocks" to cross the stream, i.e., see the "other shore" of progress.

When the "Stipulations" were issued they aroused a great deal of agitation in various areas, some comrades took them as the "ultimate goal pattern", and treated them as the reform goals of the present phase, and this can cause great disorder in the S&T structural reforms. We should fully assess the difficulty of this reform. It involves S&T management departments, enterprises, research institutes, and all science and technology personnel at all levels. Thus, we should establish a dialectical "reform view", size up the situation, and control the course of each phase of the reform. We must have both the resoluteness of reform and be fully flexible; both dare to reform and be good at reform. This is of critical importance to the effectiveness of reform. The difficulty of this reform is evident in the following areas:

First, reform of the economic system and structural reform of science and technology are not coordinated. This is manifested primarily in the fact that enterprises, especially large and medium sized enterprises do not feel pressed with regard to the demands of technology, enterprise scientific research agencies and science and technology personnel have still not been roused, so where is the initiative for independent scientific research agencies to join enterprises? Scientific research agencies which are engaged in product development ultimately should become part of an enterprise or enterprise group, but present conditions are not ripe and may not be compelling.

The second manifestation that the two are out of step is the readjustment of scientific research agencies should be consistent with the industrial structure of the national economy but the readjustment of the industrial structure has just begun and the corresponding readjustment of scientific research agencies will be retarded for a period.

Second, science and technology structural reforms are out of step with structural reform of state administration and management. This is primarily manifested in that in the functions of government department at all levels some people still consider the scientific research agencies as their own subsidiary. Implementing the separation of government and research responsibility, simplifying governmental relaxation of authority and gradually releasing scientific research agencies to the enterprise, enterprise group, and industrial central cities cannot get results in a short period of time.

Third, in the ability of scientific research agencies and science and technology personnel to endure, there should be a process of moving forward gradually. For scientific research agencies and science and technology personnel to make the transition from "eating from a big pot" and "small cycle" science and technology to the "iron rice bowl" and the "large cycle" economy requires a considerable adaptation. This can also be called a "wearing in" process, i.e., between the two should be a process of understanding and maturation.

Fourth, smashing old thinking and establishing new ideas is not an easy thing. The traces of the old system left in people's thinking are very deep. The most important thing for opening people's "ideological main gate" is to get rid of rigid and out-of-date ideas and establish new thinking and new ideas. To realize the change in people's thinking and ideas not only should patient education be carried out but also testing in reform practice.

III. Create conditions, take the initiative in reform and gain a foothold in internal reform.

Implementing the reform direction comprehensively, in terms of opportunity nationwide, the time is not yet ripe, but in terms of some areas, the time is ripe.

First, stress pilot projects which thoroughly implement the "Stipulations". In terms of the entire country, select three or five central cities, one or two departments and a group of typical scientific research agencies. Then, in terms of each province, municipality, autonomous region and department, carry out some pilot projects. In this way pilot project units of different levels and scales will take shape, the "sparrows" will dissected, the road of reform explored guiding overall reform work.

Second, study policy. Regardless of whether it is local or overall work, the spirit and substance of the "Stipulations" should be concientiously studied and understood so that everyone's understanding is unified on the foundation of this document. At the same time, a set of policies should be formulated and carried out according to economic laws, scientific reseach laws, and economic principles to reduce administrative interference as much as possible.

Theoretical research on science and technology structural reforms should be expanded and everyone should be mobilized to explore the major theoretical questions in science and technology structural reform and some practical issues encountered in reform, blaze new paths, and guide the normal conduct of science and technology legal system reform. A systematic viewpoint should be used in researching policy so that the policies are complete and are in step with reform.

In the period during which the new will replace the old in science and technology structural reform, in our work we also cannot expect to realize completeness and synchronicity of an overall nature but we should strive for partial minor completeness. When leadership comrades are implementing decisions relevant to reform from higher ups they definitely should not do things mechanically, but should consider the actual situation of their local area, department and unit and within the scope of their authority and responsibility should carry out relevant reforms with regard to areas which will be affected by reform measures and implement them completely.

Third, in taking the initiative to reform macro-control should be intensified. Reform practice of the past few years has proved that whether it is the time, place and depth of implementation of reform measures, there are difinite different natures. Therefore, one cannot sit waiting for higher ups to provide policies but should summarize the specific situation of the local

area, break through the conventions which restrict development of productive forces and formulate policies favorable to reform and relaxation. However, the policies and measures set by the local areas certainly should be favorable to the state for overall leadership of reform, conform to overall interests, and be subject to macro-control by the state.

Fourth, engage in internal reform. We cannot place our expectations of reform on special preferential policies from the state, but should pay attention to internal reform in our own areas, departments and units. Just as with invigorating scientific research agencies, simplification of administration and relaxation of authority by the departments in charge is certainly important, but the key to whether or not the scientific research agency is invigorated after the relaxation of authority is in whether or not internal factors are invigorated. If internal reform is not done well, no matter what the external conditions are they cannot be of use. It is thus for scientific research agencies and also for localities and departments.

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